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THE PRACTICAL ENGINEER

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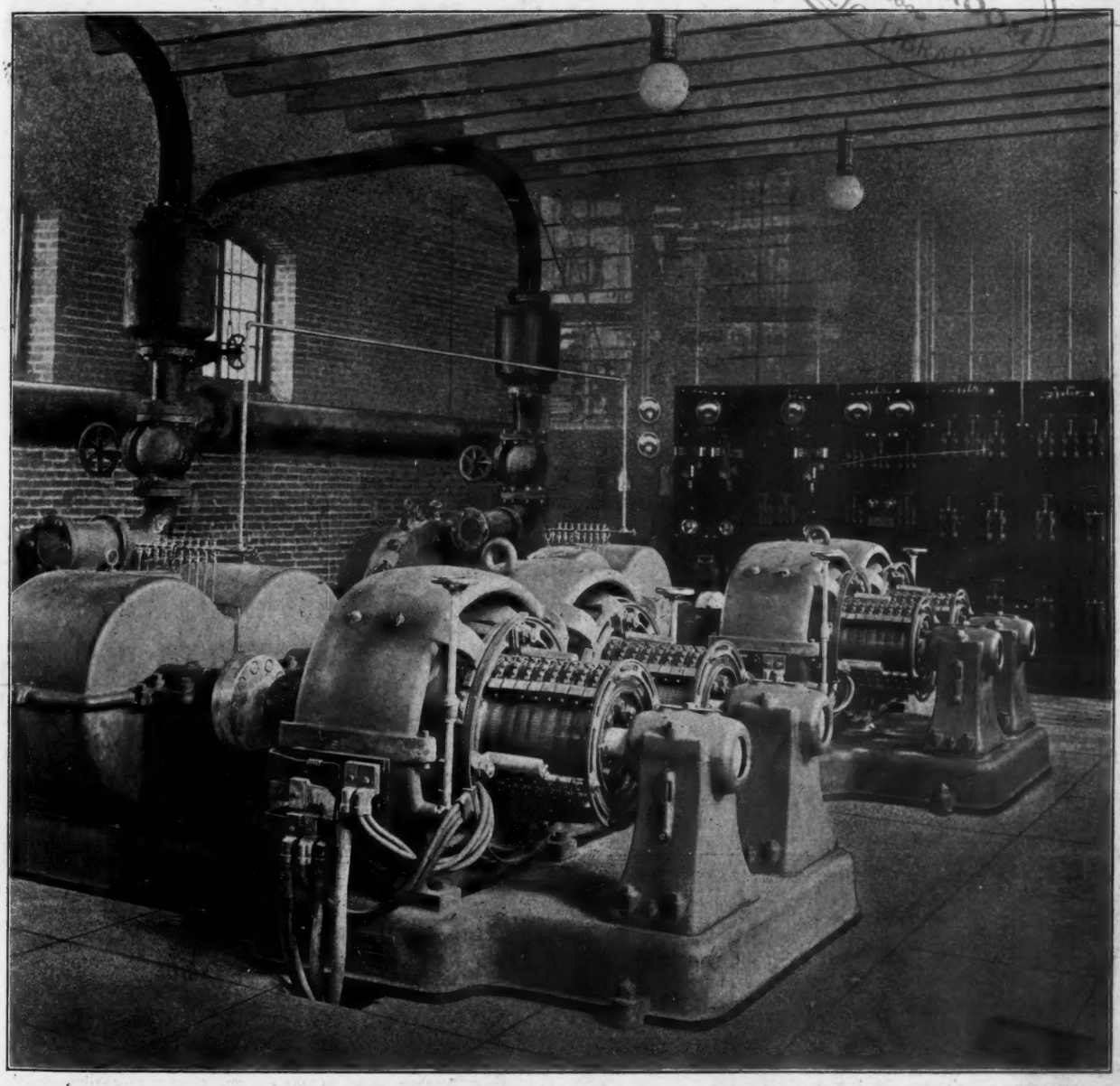
PUBLIC



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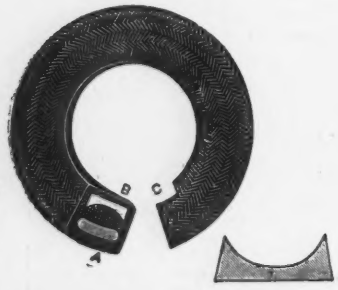

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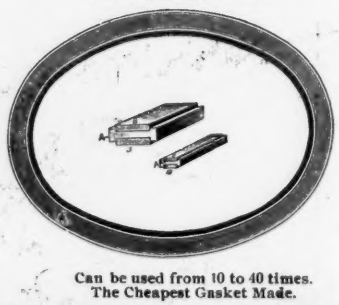

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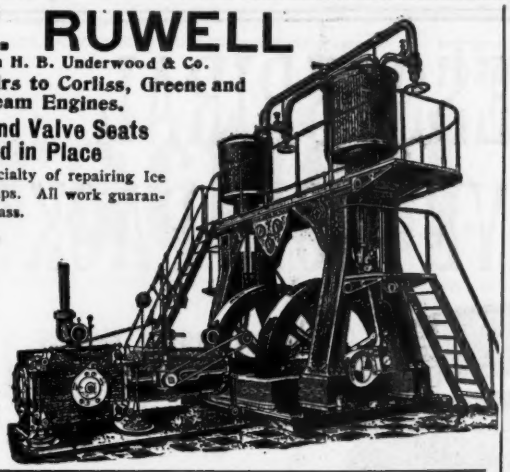

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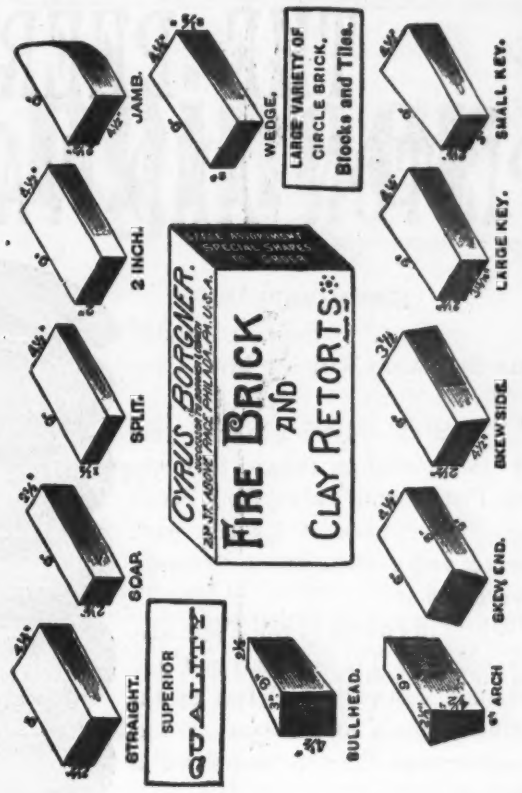

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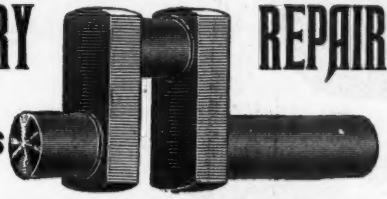

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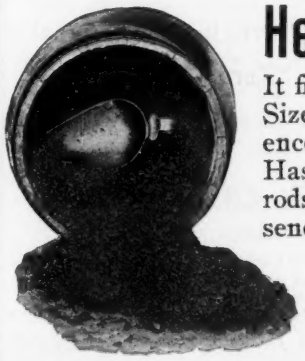

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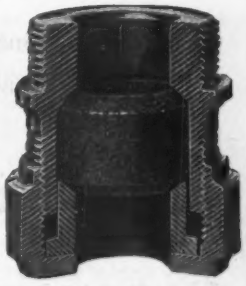

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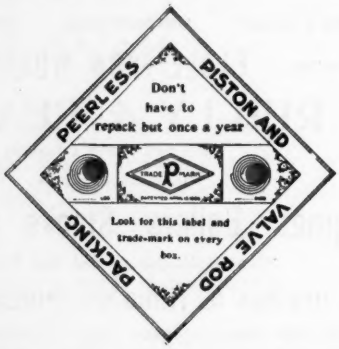

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The
Practical Engineer

A monthly journal, devoted to the economical generation and utilization of power and to the interests of stationary engineers

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The Practice of Economy

BY R. T. STROHM.

It is the laudable ambition of every enterprising engineer to do just a little better than the other fellow could do under like circumstances. And, with a power plant of even ordinary size, the engineer has always ample opportunity to show what savings and improvements he can effect, which will tend toward increasing the amount on the credit side of the account instead of adding to the debit side.

There can be no stigma whatever attached to the desire for such ends. It is a practice which should be encouraged. But it should be carried out thinkingly and not in the haphazard way in which one sees it so frequently attempted. The engineer must first locate the point where a higher economy is possible, and then, by power of reason, work to effect that economy. Unfortunately, however, there are engineers who attempt to practice economies in places where it is next to impossible to achieve them. Such efforts are simply examples of misdirected energy. The engineer who would learn to utilize to the best advantage the natural forces with which he is continually surrounded, must first of all learn to husband his own energies of strength and reason and to exert them in the proper channels. The engineer who wastes his own physical forces is usually wasteful of those of the steam plant which he controls.

There is undeniably a large field for the practice of economy in the average steam and power plant. Wherever there is a loss of heat, or a loss of energy, there is the opportunity to effect a saving. In ordinary parlance, then, the prevention of wastes is known as economizing, provided, of course, that the methods used to effect the savings do not involve an expense equal to or greater than the original loss.

In the steam plant there are several different ways in which heat can be lost, so far as the boiler and furnace are concerned. In the first place, there is the loss of heat due to the escape of the gaseous products of combustion from the chimney at a high temperature, diffusing their heat into the surrounding atmosphere.

Next, there is the loss of heat due to the moisture contained in the flue gases. This moisture enters the furnace either in the coal or in the air, or both, and it may also be formed by the combustion of the hydrogen distilled from the fuel. In the flue gases it exists as superheated steam and thus carries away heat.

Further than this, incomplete combustion causes a definite heat-loss. This is not a loss of sensible heat, but a loss of chemical heat or latent heat in the fuel. That is, there are portions of the combustible materials of the fuel which are not burned, but are allowed to pass out of the furnace, in that way failing to give up all their chemical or latent heat and thus preventing the realization of the full heat value of the fuel.

The ashes likewise carry away heat to a greater or less extent. This heat may be due purely to the temperature of the clinker and ashes or it may be that small particles of unburned fuel will fall through the grates and be thrown away with the refuse. Both of these mean loss of heat.

Again, there is the loss by radiation from the boiler and setting to the air in the boiler room, which must be charged against the economy of the plant and not in its favor. Therefore, if any savings are to be effected in the steam plant they must be carried out along one or all of the lines mentioned in the previous paragraphs as leading to heat losses.

The heat lost in the escaping flue gases is roughly 25 per cent. of the total heat in the fuel burned, in cases where chimney draft is used and no economizers or auxiliary heating apparatus are employed. That is, if a coal is used which will give out 12,000 heat units per pound, about 3,000 heat units per pound will go out at the chimney in the gases. This is by far the greatest of the losses in the stem plant.

The greatest opportunity for the practice of economy is of course at the point of greatest loss. If there is a heat loss of 20 per cent. in the escaping flue gases, then, theoretically, the greatest saving which can be accomplished by extracting further heat from these gases is only 20 per cent. This would mean that every available heat unit above the temperature of the atmosphere would be utilized and that the gases would escape from the chimney at atmospheric temperature.

Such a condition is, of course, absurd. It requires a difference of temperature of the gases inside the chimney and the air outside to produce draft, so that if the temperatures of the two were made equal there could be no draft pressure in those cases where draft is secured by natural means.

The economizer will absorb much of the heat which would otherwise be cast away in the flue gases, and thus affects a saving. But the amount of saving possible by such an apparatus must not be overestimated. For example, suppose that the

agent of some company engaged in the manufacture of economizers should make the declaration that by the installation of his apparatus a saving of 20 per cent. could be effected in the plant of which you have charge. Before placing implicit faith in his statements, it would be well for you to make a few rough calculations.

Let us suppose that the present temperature of the flue gases is 600° and that the furnace temperature is 2700°. Then, according to the agent's statements, the lowering of the temperature of the flue gases, divided by the temperature of the furnace, must equal 20 per cent. Or, denoting the final temperature of the flue gases by x, this would mean that (600—x)÷2700=.20. Solving this, 600—x=540, or x=60. In other words, the economizer would have to reduce the temperature of the gases to 60° in order to produce a saving of 20 per cent. Considering the water supply to be as low as 50°, this would allow a difference of only ten degrees between the entering water and the escaping flue gases, and this is not practical, for the reason that it would require a very large amount of heating surface in the economizer to effect any such reduction as this, and even then it would require mechanical draft. If the gases were reduced to 276° there would be a saving of 12 per cent. and this would be a more reasonable statement than the first.

The loss of heat due to incomplete combustion may or may not be large according to the percentages of carbon or hydrocarbon which are carried away without giving up their latent heat. This source of heat waste may range in value from zero to 15 per cent. of the heat value of the fuel, but as a usual thing it namounts to only a few per cent.

The loss through the clinker and ashes will be inevitable. They cannot leave the ashpit perfectly cool and so they must carry away some heat. This loss, however, is very slight, being usually only a fraction of one per cent. It is when the ashes contain particles of unburned coal that the loss of heat through the ashpit assumes serious proportions, and this loss may amount to considerable if the grate is not suited to the fuel, so that the finer portions fall through unconsumed. The remedy is to use a fuel of the proper size to suit the grate, or to change the grate to correspond with the fuel.

The radiation loss may or may not be great according to the precautions which are taken to prevent the escape of radiant heat. It may vary from 3 to 15 per cent. If the setting of the boiler is properly built, with sufficient air space and of good material, if the boiler shell is covered with a good nonconductor of heat, and if the boiler room be closed so that there can be no strong draft currents sweeping into and out of it, then the radiation will amount to very little.

There is another way of utilizing heat which would otherwise go to waste. This is by the use of a feedwater heater, which absorbs the heat that is contained in the exhaust, and transmits it to the feedwater about to enter the boiler.

One frequently reads the claims of this or that manufacturer, declaring a possible saving of ten to twenty per cent., by the use of this or that make of heater. In the first place, the heater cannot create heat. It can only give to the feedwater the heat that is put into it by the steam. Therefore, any saving which can be made must be governed by the heat in the exhaust.

Before placing implicit faith in a verbal guarantee of 10 per cent. saving, the engineer might make some estimates for his own benefit. Let us assume a case in which a boiler is carrying 120 pounds absolute steam pressure, which corresponds to about 105 pounds gauge. Let us further assume that the feedwater is being delivered to the boiler at a temperature of 160°. At 120 pounds absolute pressure the total heat in one pound of steam amounts to practically 1186 heat units above 32°. That is, it requires 1186 heat units to raise one pound of water at 32° to steam at 120 pounds pressure. But the feedwater is delivered at a temperature of 160°, which is 128° above 32°. Hence, considering the specific heat of water to be unity, each pound of feedwater at 160° possesses 128 heat units above 32° when it enters the boiler. So that to evaporate it into steam at 120 pounds absolute it will necessitate the expenditure of 1186—128 =1058 heat units.

Now, suppose that by the introduction of a feedwater heater the temperature of the feedwater is increased to 200°. One pound of water at 200° possesses 200—32=168 heat units above 32°. It is evident, then, that the amount of heat required to evaporate a pound of water from this temperature into steam at 120 pounds pressure will be only 1186—168=1018 heat units as compared with 1058 in the previous case. In other words, we expend 1058—1018=40 heat units less per pound in the latter case than in the former. The savings in per cent. is then 40÷1058=3.78 per cent. This is considerably less than 10 per cent.

However, a good feedwater heater should bring the temperature up to 200°. So let us consider a case in which the temperature of the feedwater is raised from 60° to 200°, the boiler pressure being 120 pounds, as before. With the temperature at 60°, the amount of heat required per pound would be 1158 heat units. With the feedwater at 200° it would require 1186—200+32=1018 heat units. The gain per pound would therefore be 1158—1018=140 heat units, which represents a saving of 140÷1158—12.18 per cent.

From the examples here given it is evident that the lower the boiler pressure the greater the percentage of saving effected by a certain definite increase in the temperature of the feedwater. In an ordinary plant carrying a steam pressure of such intensity as to operate engines, a saving of 20 per cent. is not possible unless the feedwater is heated to a point considerably above the atmospheric boiling point. It may be interesting to show just what rise in temperature would be required to effect a 20 per cent. saving in the case of a boiler carrying 120 pounds absolute steam pressure. Let us assume an extreme case, with the feedwater at 40°. This means the expenditure of 1178 heat units per pound. Let x be the heat units per pound required after the water is heated. Then (1178—x)=1178=.20 or 1178—x=235.6. From this, x=942.4 heat units. This would mean a saving of 1178—942.4=235.6 heat units per pound, or a rise of feedwater temperature of 235.6° above its former temperature. This would correspond to a final temperature of 275.6°. Such a temperature could not be obtained by means of the ordinary feedwater heater, though it might be produced by use of an economizer.

The point to be kept in mind, however, is that it is impossible to make a greater saving than the conditions will allow. That is, if there is a loss of ten per cent. by radiation, only ten per cent. can be saved, by the use of nonconducting coverings. If the chimney gases waste twenty per cent., then only twenty per cent. is the maximum possible saving. In reality, it is not possible to reduce any of these losses to zero, but the maximum economy which can be attained is fixed and limited by the amount of loss.

Theories Which Sometimes Fail

The general opinion of the public, when a boiler explodes, is, that unless the engineer allowed the water to run low, the cause of the explosion is a mystery. Whether the boiler was strong enough to hold the pressure, appears to be a point to which no particular importance is attached. As a matter of fact, it is a mystery why more boilers do not explode. For example, the *Locomotive* printed a story of a boiler which ought to have exploded long ago, according to all reasonable lines of argument and methods of prognosis; yet it is still running, after nearly half a century of service, the total outlay for repairs during all that time having been an old-fashioned copper coin. About 1853 Mr. Chauncey Pease, of Cooperstown, N.Y. so the story goes, had a steam boiler built in New York City, by some one whose name is long forgotten. It is a horizontal tubular, with a dome, and is rated at 15 horse-power. It is 9 feet long and 36 inches in diameter, with thirty-seven 2-inch tubes. It is made of iron, in three courses, and single-riveted, with the rivets pitched two inches from center to center. There is no glass water-gauge on it, but there are three try-cocks. When it was to be installed, it was sent by rail to Fort Plain, N. Y., and transported thence by teams over the country to Cooperstown (a distance of perhaps 30 miles), where it was in use two years by Mr. Pease. It was then sold to Messrs. Barnes & Fox, who moved it by team to the town of Maryland, on the Delaware and Hudson Railroad, some 15 or 20 miles from Cooperstown, and used it for ten years in a sash and blind factory. At the end of this time Mr. F. M. Fox, the present owner, bought the factory, and moved the boiler a few miles to Colliersville, where for thirty-three years more it has done service in his sash and blind factory, and is still in daily use.

Thirty years ago it leaked slightly, where the dome was riveted to the boiler. The hole was hardly large enough to insert a fine knitting-needle, and Mr. Fox enlarged it to a diameter of one-eighth of an inch, and plugged it with a copper ri vet made from an old-fashioned copper cent. With this exception, no repairs have ever been made on the shell or tubes of the boiler. The fuel with which the boiler has been fired has been the waste of the mill, with a little coal when there was not waste enough for that purpose. The safety-valve has been kept set at 80 pounds, but the actual pressure used in all these years has been (and is still) 60 pounds. No one has been inside the boiler, except on one occasion, some eighteen years ago. It is cleaned out as well as it can be without getting into the boiler every three weeks, the tubes being cleaned oftener. There has never been a regular engineer caring for the boiler; it has had all its attention from the proprietors and the men about the mill. The first engine used with it was of ten horse-power, but a change was made thirty years ago and a thirty-five horse-power engine substituted, running at 60 strokes to the minute, under 60 pounds of steam. After a time Mr. Fox modified the engine so as to make it run at 90 strokes to the minute under 60 pounds of steam, and it is now working at this speed under the personal supervision of Mr. F. M. Fox, who is hale and hearty at nearly seventy years of age. This history has been given at some length in order to show what boilers will do,—sometimes. On the other hand, instances might be related in which men were killed and maimed, and much property was destroyed, by boilers only two or three months old, and which were supposed to be in perfect condition. It is the old story of the unexpected which often happens. Boiler explosions do not always occur when we think they ought to, and they often do occur when common reasoning would indicate that they ought not.

The Use of Petroleum as Fuel

Oil-burning by means of an injector intended to spray or atomize the fuel is not of recent date; oil-burning devices in which the oil is driven by a jet of steam, or, in some cases, by compressed air, in the form of spray into a combustion chamber, together with the amount of air necessary for its consumption, having been in vogue for a number of years. Such a system was patented in England as early as 1865 and 1867, less than a decade after Col. Drake, drilling the first oil well at Titusville, had made petroleum of commercial importance. A similar arrangement was patented in Glasgow in 1868. But the inventors of these burners, while recognizing some of the fundamental principles of the successful burning of fuel oil, yet omitted those minor essentials such as the spraying of it against or over a white hot refractory surface, which it was left to the genius of the American people to adopt and to perfect. Remembering then the crudeness of the burners, the length of the haul of the oil, and its considerable cost up to this time, even at the well, it is not surprising that the fuel has never revolutionized economic conditions in England, where both coal and labor are cheap. That its use even there, however, has passed the experimental stage, is shown by the fact that the Great Eastern Railway, in 1897, had 37 locomotives, 13 stationary boilers and four furnaces equipped in this way.

In Russia, however, is found the most general use of petroleum fuel. The Russian oil, which closely resembles the Beaumont product, has a large percentage of residuum, this giving a high fire test and is an ideal fuel. The value of the oil as fuel was recognized in 1884 in a paper by T. Wegeboat, read before the Institute of Mechanical Engineers; as a result of his investigations and of experiments carried on by the Russian Government, its use became so general that in 1890 some 600, 000 tons were used for interior navigation in Russia alone. Since that time the use of the oil has constantly increased, and to-day practically all railroads and steamship lines in Russia, Siberia and Bulgaria use this fuel.

Recommendations of the Boiler Makers' Association

At the recent meeting of the Master Steam Boiler Association, held at the Great Northern Hotel, Chicago, Ill., the following conclusions and recommendations were adopted:

Inspections of Boilers.—Boilers will hereafter be inspected by the following method: First manholes and other covers should be removed and, after a thouough examination of the boiler in and outside, the actual measurements taken of all brace stays, seams, etc., and the working pressure to be found by a series of calculations formulated by the association, after which the covers are to be put on and the hydraulic pressure applied.

Factor of Safety.—A factor of safety of five was adopted by the association on cylindrical shells of boilers.

Rivet Holes.—Recommended that all rivet holes be punched 3-32 inch small and afterward reamed to the desired size.

Tell-tale Staybolt Holes.—Recommended that all tell-tale holes in staybolts be drilled on the outside and the flue sheet and four or five upper rows of staybolts be drilled on the inside of the firebox on the side sheets.

Staybolts.—Lack of time prevented extended discussion of ultimate decision, but it is recommended that the matter of staybolts be given every possible attention during the coming year and brought up for discussion again at the next convention. Twelve threads to the inch was adopted as the standard for all staybolts and staybolt taps.

Friction Against Space – or Frictional Heat in the Magnetic Field

Modern science has demonstrated that motion is absolutely necessarily and universally perpetual; that the total quantity of motion, or force, or matter (which are really convertible terms) in the universe, is precisely the same, as it was, is, and will be the same evermore.

The fundamental necessity of this principle of perpetual motion is, that force must be and is applied to material substances, converting energy into heat and mechanical motion. Moreover, perpetual motion necessarily can never have had an initial momentum, and, therefore, can never end. Matter and motion are indestructible, the eternal cycle of rotating matter never had a beginning, and will never cease. All material things in the infinite expanse of space are in perpetual movement in an electromagnetic ether, which, like the atmosphere, surges and resurges by the reaction of heated globes like the sun and planets. Vast cyclonic heat waves from the sun spread over an enormous area, yet when they reach our earth's atmosphere they are intensely cold, and even after penetrating our atmosphere are incompetent to melt the snows which perpetually cover the mountain tops above the line of perpetual frost. This proves that space is diathermal; that is, heat passes through it without imparting sensible heat, but the atmosphere is a material substance composed of gases which resist heat, the solar heat and light does not warm or light space, but it certainly does modify the electrostatic condition of the interplanetary space, which is centered on the plane of the ecliptic or solar equator. In this manner this inter-space is a vast cyclonic solar heat wave, occupying an intermediate region between two regions of ether, which are outside the sun's heat energy, and, therefore, of a higher electrostatic capacity. From these nether regions the electromotive force which causes the rotation of sun and planets, incessantly pours upon the poles, of the sun and planets visible to us as the sun's corona, observed during eclipses, and on our earth's poles as the glorious crowns of auroral radiance.

The moon has no crown of light at either pole; it has no air or water, because it has no motion of its own, does not rotate on its axis—it is an extinct world. Atmosphere and seas frozen with such an intensity of cold that the gases, oxygen, nitrogen, etc., are solidified.

The question now arises, why should the earth have an atmosphere and the moon not?

The answer is, the moon exerts no friction against space, it is a rigid immovable body, it performs an orbit around the earth's axis, on which it turns. It is a fixed magnetic globe, its nearness to the earth has deprived it of all energy of its own, all its movements are controlled by the superior bulk and force of our planet, and which stopped the moon's rotation on its axis long ago.

Our globe is covered by an ocean of water and enveloped in an atmosphere composed of oxygen and nitrogen. The ocean another mixture of hydrogen and oxygen. The liquid and gaseous condition of these gases is due absolutely to the earth's internal heat.

Were it not for the earth's internal heat, our atmosphere and oceans of water would be frozen by the intense cold of space which is estimated 400 or 500 degrees below zero Fahrenheit—sufficient to solidify air. Liquid air has been produced by low temperature. Low temperature means compression.

Space by reason of its extremely low temperature, therefore, is ever exerting a compressive or contractile force upon all matter. It has been aptly termed an ether adamant, and we now can easily infer that it exerts great resistance to motion.

The magnetic field, as explained in the article "Magnetolysis," produces separation of the atmospheric gases; it also creates a void space in a steel casting (see Electromotive Force) It is easy to compare the ether adamant to an infinite magnetic space.

The magnetic field can be compared to a space devoid of all matter but which it replaced by the ether adamant.

This ether adamant permeates all material bodies, the interspaces between the molecules of every substance are held together by attraction of cohesion, or in other words, by intense magnetism. The application of heat energy or motion sets up a vibratory movement of the molecules, especially in metallic substances, hence they are termed good conductors.

This vibration is intensified if we place the material in a magnetic field, which I will explain and illustrate later on.

Our globe rotates on its axis with a velocity of 1000 miles an hour. It is an electrodynamic engine. Its heat is developed by friction against the magnetic ether adamant, which presses upon and ever exerts a retardatory resistance to its motion.

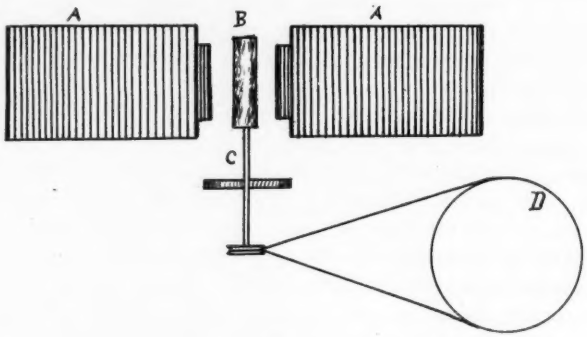


Fig. 1

It is loaded, so to speak, and in overcoming that load it becomes heated exactly as an overloaded dynamo.

Let us now examine particularly how the magnetic field transforms electromagnetism into heat by applied mechanical force.

Professor Tyndalls "Heat, a Mode of Motion," contains the following striking experiment, which proves beyond a peradventure, the transformation of latent electricity (magnetism) into heat by *friction against space.*

Fig. 1. AA, two coils of a powerful electromagnet drawn horizontally for simplicity of detail, but are yoked together by a half cylinder of soft iron forming a convenient base for the coils.

B, a copper cartridge or capsule containing a hard but fusible alloy, supported by a spindle. C connected by a cord which can be set in motion by a whirling table D.

After 1½ minutes rapid rotation of the cartridge, the fusible alloy began to sputter. A plug was inserted to prevent its scattering by centrifugal force; in 30 seconds more the melted alloy was poured out before the audience.

A copper disc revolving between the poles of the same magnet became heated, the same result is evidenced by rotation in a vacuum chamber.

The magnetic field and space are thus synonymous terms. The ether adamant replaces the exhausted air in both instances.

The interspaces between every molecule are filled with this subtle ether. Any disturbance produces a change in their normal position, expansion upon the application of heat motion alternating contraction upon the cessation or reversal.

The magnetic field by its inertia resists motion, and, therefore, every molecule in that copper cartridge was alternately polarized and depolarized, every molecule rotated on its axis in the same direction, therefore, violent friction ensued every

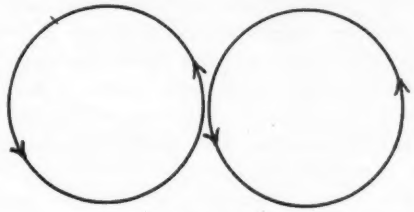


Fig. 2

molecule rubbing against its neighbor. Fig.. 2 will make this plain. Two molecules, each rotating in the same direction, denoted by the arrow heads, necessarily move in contrary directions to each other, and perforce rub against each other. The countless molecules under these conditions are maintained in violent commotion, frictional heat is thus developed, not only against the outside magnetic field, but the magnetic interspaces between each molecule.

This is an astonishing indication of the truth of Amperes theory.

The globe on which we live, move and have our being, is a spheroidal case revolving with tremendous velocity in a magnetic ether, its interior is heated exactly as that fusible alloy in Fig. 1. As above explained, every molecule is alternately polarized and depolarized, a constant vibration ever goes on. There is not a quiet spot in the earth beneath or above. Earth sea and air is in constant movement.

Beneath onr feet is a huge caldron of molten lava, enclosed in a comparatively solid casing of cool matter, which is again covered by water and an atmosphere of gaseous oxygen and nitrogen.

The internal molten lava ever seeks a vent in the form of volcanoes. Earthquakes are a vivid manifestation of earths tremors. Geysers, natural gas wells, petroleum wells, thermal springs, are incontrovertible proofs of this internal heat.

Volcanoes are the safety valves, which relieve the Terrestrial boiler of its superfluous steam. Water constantly percolates through the earth's crust, causing an increased expansive force, by accumulating steam; an explosion takes place, relieving the strain, otherwise the whole globe would explode and overwhelm us in a universal boiler explosion.

The earth is thus a huge spherical boiler containing a whirling mass of molten lava or melted rocks and earthy material.

The Terrestrial heat thus generated by friction against space, serves another purpose, which has been strangely overlooked by the scientific world.

I refer to the expansive force below us which sustains an ocean of liquid water and a gaseous atmosphere without which life would be impossible.

A diversity of opinion exists as to whether the earth is solid to the centre, or is a molten sea of lava and gases.

The above example should settle this question. The solid earth theorists maintain that the earth is heat due to chemical action, and completely ignore the mechanism which actuates and governs the earth's motion.

There can be no doubt that chemical changes are ever going on; the earth is one huge chemical laboratory. The earth's rotation and its inclination on its axis maintains a constant trituration and admixture, but not one of these chemical actions can take place without oxygen, hydogen, or nitrogen. These three elementary gases form our oceans of water and air and are essential to all forms of organic matter and life.

Water covers over five-eighths of the earth, and penetrates deeply into the interior.

The atmosphere surrounds our globe to a great height and shields us from the terrible cold of space. It developes the sun's heat and light as a crystal convex lense, thus returning to us a portion of the heat-energy which the sun abstracts from the earths mass by its slow but sure attractive power and retardation.

The very existence of the atmosphere depends on the earth's internal heat, and as long as the earth's rotation is maintained, just so long will the oceans of water and air exist. Thus reasoning, the earth is a heated body, surrounded by liquid and atmospheric gases, which otherwise would be solidified as on the moon's surface.

The sun is an incandescent globe of matter fired by friction against space to an intense degree of incandescence, it is as I stated in a previous article, an incandescent electric arc light, rotating on its axis at a speed of 70 miles a minute, and is 1,300,000 times larger than the earth.

Electricity is truly motion itself. Perpetual, because never wasted or lost. Matter is electromagnetic by its immersion in the electrostatic ether-adamant, it is actuated and governed by electromagnetic law. Heat is developed by friction against space. Light is a development proceeding from the primary and secondary.

Nature is a strict accountant—a perfect balance is kept in her ledger. Perpetual motion is the result.

Any piece of mechanism which requires starting must inevitably stop sooner or later. Humanly speaking, perpetual motion is an utter impossibility, because we have to overcome not only the force of gravitation, but friction against the atmosphere, and above all and through all. Friction against space, because the earths rapid movement and tremors upset any humanly devised machinery. The earth is, therefore, an unstable and ever shifting zero.

The sun heretofore has been credited as the heat giver to our globe, but if we accept the idea of the earth's heat force, we must look the fact squarely in the face, that the sun is depriving us imperceptibly of motion, as surely as the earth deprived the inferior moon of its axial rotation leaving it a cold dead world.

I will discuss this subject in a future article on Gravity and Gravitation.

A. G. WILLIAMS.

The World's Fuel

Production and Consumption of Coal Throughout the World

In view of the great coal strikes which were recently settled in this country and in France, and in view of the fact that the coal question is universally growing more and more important, it will be of interest to compare some international figures bearing upon the world's coal supply and consumption.

The five most important coal-producing countries of the world are: The United States, Great Britain, Germany, France and Belgium. During the year 1901 the production of coal in these countries was as follows (in round figures):

	Tons.
United States	261,000,000
Great Britain	220,000,000
Germany	109,000,000
France	32,000,000
Belgium	22,000,000

THE BITUMINOUS VARIETY.

The world's total production of bituminous coal is estimated at 700,000,000 tons per year, of which Great Britain produces a little less, and the United States a little more than one-third. Taken per capita of the population the production is greater in Great Britain than in the United States. The output averages 5½ tons per inhabitant for Great Britain, and 3¾ tons for the United States. The British colonies and possessions produced in 1901 the following quantities of coal:

	Tons.
Australia	6,400,000
East India	6,120,000
Canada	4,800,000
New Zealand	1,095,000
Natal	241,000
Cape Colony	170,000

EXPORTED IN 1901.

The exports of the principal coal-producing countries of the world were in 1901 as follows:

	Tons.
Great Britain	58,405,000
Germany	18,055,000
United States	8,295,000
Belgium	6,940,000
New South Wales	3,370,000
Japan	3,350,000
British India	543,000
Natal	95,000

The following countries import the largest quantities of coal, the figures given relating to the year 1901:

	Tons.
France	14,000,000
Austria-Hungary	6,865,000
Italy	4,950,000
Russia	4,490,000
Canada	3,950,000
Sweden	3,130,000
Spain	2,000,000
Victoria	691,000
South Australia	501,000
Cape Colony	336,000

THE DOMESTIC CONSUMPTION.

The domestic consumption of coal in the principal countries was in 1901 as follows:

	Tons.
United States	255,470,000
Great Britain	98,000,000
France	45,000,000
Russia	20,000,000
Belgium	19,000,000
Austria-Hungary	18,000,000

It will be seen from these figures that the United States consumes far more coal than any other country in the world. The relatively small consumption of bituminous coal in Germany and France may be traced to the fact that in these countries large quantities of other fuel, such as peat, brown coal, lumber, alcohol, etc., are used.

Great Britain has been and still is the principal source of coal for those countries of Europe which depend upon importation. The great bulk of the British coal exportation finds its way into Germany, France, and Italy. Nearly one-half of the total British exportation goes to these three countries.

Great strides ahead have been made in the brown coal industry of many countries. Germany produced nearly 42,000,000 tons of it last year, and Austria-Hungary in the neighborhood of 27,000,000 tons.

The exports of coal from the United States have especially increased during the last few years. In 1892 they amounted only to 1,700,496 tons, but in 1901 the exports aggregated nearly 6,000,000 tons. The value of all coal exported from this country in 1901 was $23,750,993.

The best buyers of American coal are Mexico and Canada.

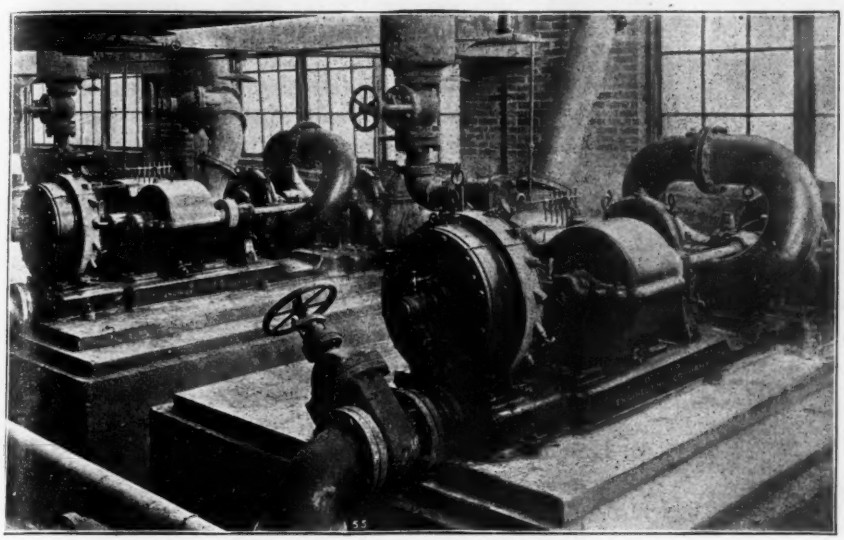
The Standard Electric Transmission Company transmits power 215 miles from the Blue Lakes power house via Oakland and around the southern end of San Francisco up to Redwood, Cal.

It is stated that the overall efficiency of this transmission, measured to the receiving step-down transformers at the terminus, was as high at full load as 80 per cent. The power is utilized for lighting, electric railway and general power purposes, and a very considerable portion of it is used also in the operation of shovels and other tools used in placer mining in the gravel drifts near the power houses. In both of these plants the hydraulic equipment consists of high-head, high-velocity impulse wheels, and each plant has a capacity of about 10,000 kilowatts.

Andrew Carnegie has been much in the eyes of the world during the past month. On one side of the Atlantic Ocean he was honored by being elected President of the British Iron and Steel Institute, an honor never before conferred on any man not a British subject, while on this side of the ocean he put forth a plan, backed by $1,000,000, for a great building to be erected as a home for the chief engineering societies of the United States. Mr. Carnegie's activity seems to increase as time passes and every one wonders what his next move may be in the accomplishment of his purpose to make good use of his millions while he is alive to enjoy the results. His latest proposition will be appreciated by every engineer who is sincerely interested in the future of his profession.

Steam Turbines at the Pennsylvania Sugar Refinery

The question of efficiency of the steam turbine engine is now one of the leading points for discussion among engineers, hence the following article, which is descriptive of one of the largest steam turbine installations in America, will no doubt be of great interest. The plant in question is the Pennsylvania Sugar Refinery, located on the Delaware River, at Philadelphia.



Steam Turbine Pumps for Vacuum Pan Condensing Water

The plant was designed by the George M. Newhall Engineering Co., of Philadelphia, and installed complete by the D'Olier Engineering Co., Philadelphia.

The power machinery is a practical demonstration of the efficiency of the DeLaval Turbine engines and shows the wide range of working possibilities of this type of engine.

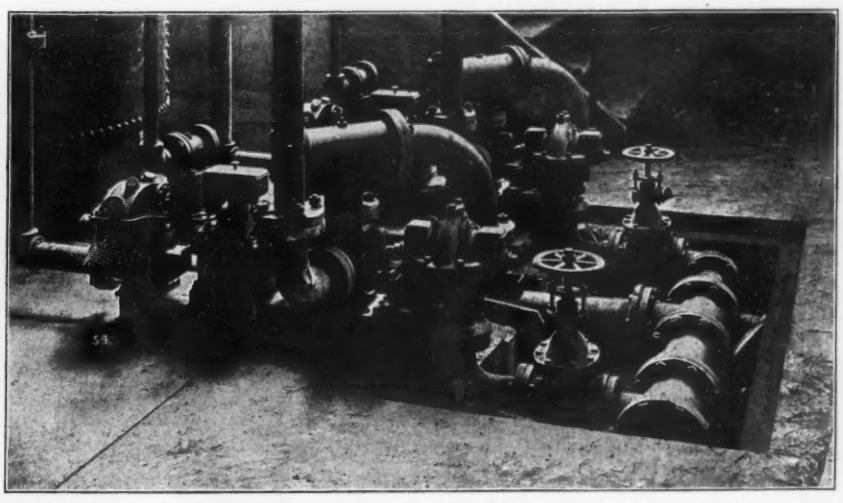
The application of electrical power throughout the entire refinery, marks a decided advance in the modern application of power over the long established methods. With certain apparatus the character and application of power, which, previous to this installation has been considered impracticable, has not only been proved successful, but efficient.

The boiler plant consists of six water tube boilers set two in battery, each boiler having a capacity of 500 horse power at 150 pounds pressure and equipped with mechanical stokers, coal being supplied by a complete conveying and crushing plant. The ashes are disposed of by means of a system of conveyors and elevators. The boilers supply steam for power and all sugar refining purposes. Natural draft is furnished by a radial brick stack, 175 feet in height; the boiler gases pass through an economizer before entering the stack. Feed water is supplied by Steam Turbine high pressure series centrifugal pumps set and connected in duplicate, with a capacity of 150 gallons per minute against 150 pounds pressure. Condensing water is supplied for both the power generating plant and the sugar vacuum pans by Steam Turbine low pressure centrifugal pumps, two in number, with a total capacity of 5000 gallons per minute on various heads from 15 feet to 100 feet. All wash-water furnished to the refinery is supplied by Steam Turbine centrifugal pumps through pressure filters.

All sugar liquors, sweet water and syrups are pumped by electric motor centrifugal pumps, automatically controlled.

Power is generated for all sugar making apparatus, conveyors, elevators and sugar and coal conveying systems in the yards and on the dock by steam turbine driven electric generators, direct current, 250 volts. The exhaust steam from the turbines driving the generators and centrifugal pumps is turned into a surface condenser, and as no oil is required in the steam to lubricate the turbines, a clean, pure boiler feed water is obtained direct from the surface condenser. The dynamos are twin type, two 100 kw., 125 volt generators direct connected by flexible couplings to each 300-h. p. Steam Turbine, the complete unit being mounted on a single subbase. The generators are connected up so as to operate on a two-wire system of power and a three-wire for light distribution. The switch-board is arranged with a double dynamo panel for each generating set, and three feeder panels.

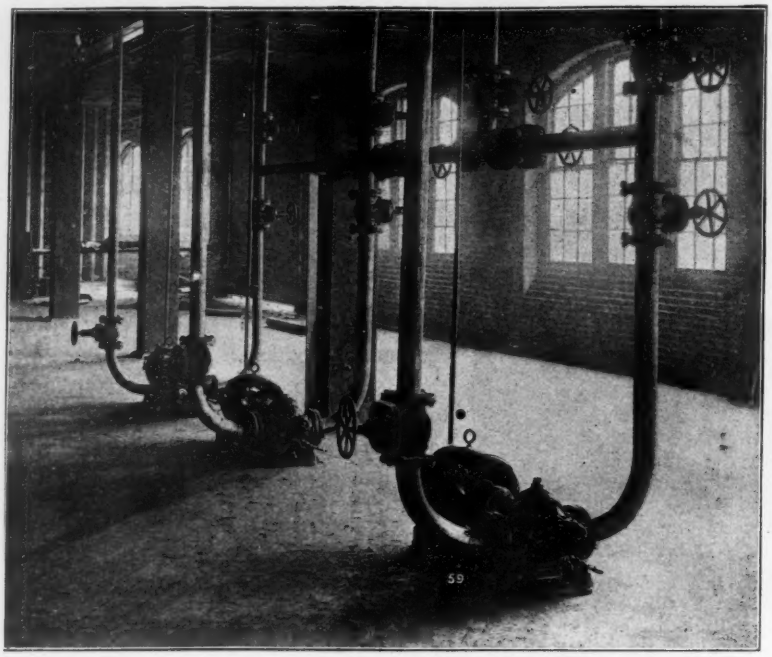
Voltmeters are connected to the generators and bus-bars, and a separate ammeter is connected on each 100-kw generator, remaining constantly in circuit. All dynamo and feeder circuits are protected by circuit breakers and controlled by switches. Connections between generators and switch-board are made with lead covered cables, carried in iron floor ducts. From the switch-board feeders are carried in direct lines in vitrified ducts to various centers throughout the refinery plant. Risers and all branch circuits are installed in steel conduit.



Steam Turbine Pumps for Boiler Feed

Individual motors are generally installed for the various sugar making apparatus, being direct coupled or belted, geared or connected by silent chain drivers. The application of motors

to some of the apparatus presents new features, and the motors are ingeniously applied. Several motors are used for drives of groups of smaller apparatus. Controlling appliances for each motor are conveniently located.



Electrically Driven Turbine Pumps for Sugar Liquors and Sweet Water, in Pan House

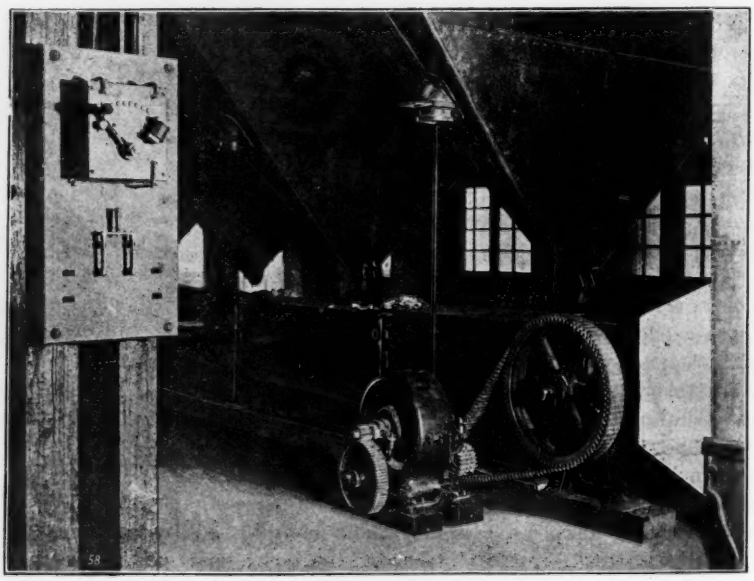
Illumination is thoroughly provided, the arrangement and location of lights having been carefully considered. The installation of the lighting system is both electrically and mechanically nearly perfect. Steel conduits are used throughout. All fittings and appliances are solid and substantial; the troublesome and annoying cord drop has been dispensed with. Arc lamps illuminate the boiler and power house, yards and dock.

When the sugar is received from the dock conveying system at the melter house, it is conveyed to the top floor in the original packages and is worked through the various apparatus in the melter house, all of which is electrically operated. In the course through the melter-house, the working of the sugar in the centrifugal machines and the pumping installation are particularly worthy of mention.

The centrifugal machines are operated in a highly satisfactory manner by individual special motors, each directly connected by belt, attaining speed quickly and delivering raw sugar uniformly cured. The operation of the centrifugal machines will be fully described later in this article in connection with the centrifugals working on refined sugar. The melter, syrup and sweet water pumps are all of the centrifugal turbine type, operated by electric motors directly connected through flexible couplings. In the char-house, elevators and conveyors are operated by individual motors back-geared and connected by silent chain driver. The cooler blowers and duster exhausters are operated by individual motors directly connected.

The sugar liquor is received in the pan house from the char-filters and pumped to the top floor of the pan-house by centrifugal pumps, operated by electric motors directly connected. The various sugar making apparatus is operated by individual motors connected by belt or silent chains drives or directly connected. The centrifugal machines are operated in the same manner as previously described for the raw sugar centrifugals. Each centrifugal machine is connected directly by belt to an individual motor, especially designed to meet the requirements of the work to be performed. The motor is started and stopped by means of a lever switch located at the centrifugal machine. The motors are positive and reliable in their action, bringing the centrifugals up to full speed in any predetermined time ranging from 30 to 90 seconds. This time limit for attaining the ultimate centrifugal feed is adjusted in the starting mechanism and is beyond the direct control of the centrifugal operator. The quick starting feature attained by the special motor drive, produces a perfect vertical sugar wall and uniformly cures in 2¾ minutes a single charge of sugar.

This special motor drive has resulted in a marked increase in the working capacity of a given number of centrifugals. No previous system of drive, either mechanical or hyraulic has demonstrated an operation of the centrifugal machines equal to this special individual motor drive. With this drive, a multiplicity of belts, pulleys, idlers and friction clutches is dispensed with, all of which have proven annoying, dangerous and costly in maintenance.



Char Conveyor, Showing Silent Chain Drive

In reading this article it will be observed that the operation of turbine engines is both practical and efficient. Also the saving effected in floor space, as well as weight of machinery, becomes an item worth considering.

The Relation of Ammonia to Freezing

The process of mechanical refrigeration is simply that of removing heat, and mechanism is necessary, because the rooms and articles from which the heat is to be removed are already as cold, or colder than their surroundings, and consequently, the natural tendency is for the heat to flow into them instead of out of them. The fact that a body is already cold does not prevent the removal of more heat from it and making it still colder The term cold describes a sensation and not a physical property of matter; the coldest bodies we commonly meet with are still possessed of a large quantity of heat, part of which, at least, can be abstracted by suitable means. The only means by which heat can be removed from a body is to bring in contact with it a body colder than itself. This is the function that ammonia performs in mechanical refrigeration. It is so manipulated as to become colder than the body we wish to cool. The heat thus abstracted by it is got rid of by such further manipulation that (while still retaining the heat it has absorbed) it will be hotter than ordinary cold water, and therefore, part with its heat to it. Ammonia thus acts like a sponge. It absorbes the heat in one place and parts with it in another, the same ammonia constantly going backward and forward to fetch and discharge more heat. The complete cycle of operation comprises three parts:

1st. A compression side, in which the gas is compressed.

2nd. A condensing side, generally consisting of coils of pipe, in which the compressed gas circulates, parts with its heat, and liquifies.

3rd. An expansion side, consisting also of coils of pipe, in which the liquefied gas re-expands into a gas, absorbs heat, and performs the refrigerating work.

In order to render the operating continuous, these three sides or parts are connected together, the gas passing through them in the order named. The liquefied gas is allowed to flow into the expansion or evaporating coils, where it vaporizes and expands under a pressure varying from 10 to 30 pounds above that of the atmosphere when ammonia is the agent in use. The gas then passes into the compressor, is compressed and forced into the condensers, where a pressure from 125 to 175 pounds per square inch usually exists; here liquifaction takes place and the resulting liquefied gas is allowed to flow to a stop-cock having a minute opening, which separates the compression from the expansion side of the plant. The expansion side consists of coils of pipe similar to those of the condensing side, but used for the reverse operation, which is the absorption of heat by the vaporization of liquefied gas instead of the expulsion of heat from it, as in the former operation. Heat is conducted through the expansion or cooling coils, and is absorbed by the vaporizing and expanding liquefied gas within such coils, for the reason that they are connected to the suction or low pressure side of the apparatus from which the compressors are continually drawing the gas and thereby reducing the pressure in said coils, as already stated, to a pressure of 10 to 30 pounds above the atmosphere; it being kept in mind that liquefied ammonia is again assuming a gaseous condition, has the power or capacity of reabsorbing, upon its expansion, a large quantity of heat. The liquefied gas entering these coils through the minute openings of the stop-cock, above referred to, is relieved of a pressure of 125 to 175 pounds, the amount requisite to maintain it in a liquid condition, when it begins to boil, and in so doing passes into the gaseous state. To do this it must have heat, which can be supplied only from the substance surrounding the pipes, such as air, brine, wort, etc. As a natural result the surrounding substances are reduced in temperature, or cooled. It is apparent from the foregoing that if the expansion coils are placed in an insulated room, that room will be refrigerated; also, if brine or wort is brought in contact with the surface of the coils, they also will be reduced in temperature; and that brine so cooled can be used to refrigerate an insulated room by simply forcing it to circulate through pipes or gutters suspended in the same. Either of the above methods can be applied to the refrigeration of breweries, packing houses, etc., and for the manufacture of ice, the same gas being used over and over again to perform the same cycle of operations.

The How and Why of Steam Pumps

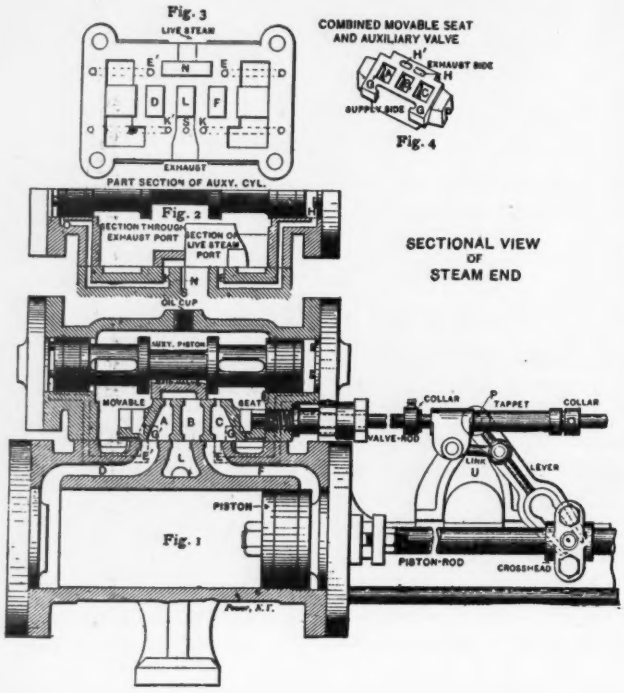
In an ordinary engine the reciprocating motion of the piston is converted into a rotating movement of the fly-wheel by means of a crank. An eccentric secured to the shaft drives the valve. With the ordinary type of pump this means cannot be employed, as there is no rotary motion which can be used to actuate the valve. A difficulty arises in this connection from the fact that when the valve is central, steam is cut off from the cylinder, and there is no momentum stored in a fly-wheel to force the valve in either direction to open the port. This difficulty exists in all pumps, and the means adopted to overcome it constitute the distinctive features of their article. In pumps, as in engines, the valve motion is derived from the stroke of the piston; and it is our pupose to describe the means of derivation employed, the methods adopted to obviate the "dead centre" difficulty, and the processes of setting the valve gear so as to secure the best results.

Figs, 1, 2, 3 and 4 represent the steam end of a Blake pump. This is the arrangement of the boiler feed and pressure pumps. First, we will consider the valve movement without any regard to the gear by which it is accomplished.

The main valve, which controls the admission and exhaust of steam from the main cylinder, is carried by the auxiliary piston, and moves on the back of the movable seat. This movable seat is shown in Fig., 4 in perspective, and the passages A, B, C, serve as steam ports to the main cylinder; while the lugs G G′ control the admission of steam to the auxiliary cylinder and the holes H H′ control the exhaust from that cylinder.

With the valves in the position shown, the course of the steam is through live steam passage N, through the port C to the right-hand end of the main cylinder, thus forcing the piston over to the left. Now, when the piston nearly reaches the left end of the cylinder the movable seat, by a means described later, is shifted over to the left, so that the lug G covers the port E, while the lug G′ moves off from the port E′, thus admitting steam behind the auxiliary piston, at the left-hand side. At the same time, the exhaust port K of the auxiliary cylinder is put into communication with the hole S which leads to the exhaust. The auxiliary piston is therefore forced over to the right, and uncovers the port A to live steam. Near the right-hand end of the stroke the operation is reversed. That is, the moveable seat, which is then at the left, is moved over to the right, assuming the position shown in Fig. 1. The lug G

then uncovers the port E, while E′ is covered by G′. This admits live steam to the right of the auxiliary piston. At the same time, the hole H′ in the auxiliary valve or movable seat, places K′ and S in communication, thus exhausting the steam from the left of the auxiliary piston. This drives the auxiliary



piston over to the left, until it assumes the position shown in Fig. 1.

The auxiliary piston is cushioned on steam, because the exhaust port is not out at the end of the auxiliary cylinder, and consequently there is steam imprisoned when the piston covers the exhaust, as shown at the left in Fig. 2. The main piston is cushioned on live steam, because the valve has lead; that is the operation of admitting steam is performed before the piston reaches the end of its stroke.

It will be seen that if means are provided to shift the movable seat from one end of its travel to the other, the rest of the operation is automatic. Fig. 1 shows the valve gear provided for this operation. The piston rod is provided with a cross-head, the latter having a pin as shown. The frame of the pump is built with an upright piece, U, to which is pivoted at P a lever whose lower end is slotted and engages with the cross-head. The valve rod, which is secured to the movable seat, is provided with two collars as shown. These collars are made of split nuts which work on a thread cut on the valve rod for a short distance on each side of their ordinary position. Between these two collars is a tappet, which is free to slide on the valve rod. The link shown connects the tappet with the lever. When the piston rod moves, the lever rotates about P, carrying the tappet with it; and when the tappet strikes either collar it moves the movable seat in the direction in which the tappet is moving. By placing the collars so that the tappet strikes them before the piston reaches the ends of its stroke, the movable seat will be shifted in the required manner.

No valve adjustment is required to be made inside the steam chest, and the only adjustment which can be performed is that of altering the distance between the collars, thus changing the travel of the valve. This is done by loosening the set screws in the collars, and rotating the latter until they come to the required point. Changing the distance between the collars alters the length of the stroke. This is easily seen, because the action of the tappet in striking the collars is what admits and exhausts the steam; and if the distance which the tappet has to travel is varied, the time at which the valve is actuated is varied, and the stroke varies as well.

The adjustment of these collars is very simple, and can be performed while the pump is running. In adjusting them it is desirable to make the stroke as long as possible and secure enough cushioning, for the shorter the stroke the greater the amount of the clearance, and the steam required to fill the clearance is wasted on every stroke.

If the collars on the valve rod are not set at equal distances from the centre line of the lever when the latter is vertical, the movable seat will be reversed sooner on one stroke than on the other, and consequently the piston will travel further in one direction than in the other.

New Electrical Equipment in a Cement Plant

A novel application of induction motors is to be made by the Belleville Portland Cement Company in their cement plant at Belleville, Ontario, which is to be equipped throughout with Westinghouse electrical apparatus.

A recent order comprises two 450-kilowatt, engine-type, alternators, one 100 kilowatt, D.C., engine-type, generator, and a motor-generator set, consisting of a 100 kilowatt, D.C., generator, and a 150 horse-power, three-phase type C, induction motor. These two D. C. machines are to be used for exciting the fields of the A. C. generators, for supplying lighting circuits and for the operation of a tramway locomotive.

Sixty-two induction motors will supply the motive power. These include forty-six type C constant speed motors, ranging in capacity from 10 to 50 horse-power; ten type F, variable speed induction motors, each to be direct geared to a rotary kiln and provided with a controller permitting the operation of the motor at any one of four speeds; two type F motors, each to be direct connected to a hoist and provided with standard non-reversing hoist controller; also four 400 volt, type C, variable-speed induction motors for the operation of two overhead traveling cranes, these being provided with reversible crane controllers.

Included in the equipment is a Baldwin-Westinghouse mining locomotive for operation on a 24″ gauge track with double trolley.

The ten-panel switchboard consists of two generator panels, three A. C. feeder panels, a double exciter panel, a D. C. feeder panel for the control of the tramway circuit, and another to control the circuits of the generator fields, and two D. C. feeder panels for the lighting circuits.

Altogether this will be a novel and interesting plant, as the operation of rotary kilns by direct connection to variable speed-induction motors is a new departure from the usual method of supplying power to this class of machines.

Colossal Steam Equipment of the 20th Century Steamship

Thirty years ago the largest steamer that entered the port of New York on regular service across the Atlantic was of a gross register tonnage of 4,670, her length was 440 feet, her beam 44 feet, and her horse-power 3,000. The passenger accommodations on the steamers of that period were commensurate with the size and speed.

As against the modest dimensions of the largest steamship of those days we have to-day more than forty-five stemships of from 10,000 to 20,000 tons gross register employed in regular lines between the port of New York and ports of Great Britain and Continental Europe, not to mention the large fleet of vessels of a tonage between 5,000 and 10,000 tons gross register. The horse-power of these modern ships, says Cassier's Magazine, varies according to the service for which they were built. The large freight steamers have from 8,000 to 13,000 horse-power, whereas the express steamships develop from 20,000 to 40,000 horse-power.

The last addition to the large fleet of fast transatlantic liners is the steamship Kaiser Wilhelm II, of the North German Loyd, built by the Vulcan Shipbuilding Company, of Stettin, Germany. The dimensions of the new vessel are:

Length over all	706 ft. 6 in.
Beam	72 "
Height from top line of keelson to moulding of promenade deck	22 " 6 "
Draught to load line	829 " 6 "
Displacement	26,500 tons.

The two bronze propellers are 22 feet 10 inches in diameter, and each of them is driven by two four-cylinder, three-crank quadruple-expansion engines, each set of two engines developing 20,000 horse-power. The two engines on each shaft are placed tandem, and are separated by a transverse bulkhead between each engine in addition to the longitudinal bulkhead in the engine-room; a separate water-tight compartment is thus provided for each of the four engines. The crank shaft and the thrust shaft are made of nickel steel, while the screw shaft is of crucible steel, and the connecting shafting of Siemens-Martin steel. The length of each set of two engines is 92 feet, and the height 43 feet 4 inches. The high-pressure cylinder is placed above the first intermediate; next to the first intermediate comes the second intermediate, and then the low-pressure cylinder.

To provide the necessary steam for these four engines twelve double and seven single boilers are provided, working at a pressure of 213 pounds, and having a heating surface of 107,643 square feet. There are 124 furnaces, with a grate area of 3,121 square feet. The bunkers contain space for 5,700 tons of coal The boiler rooms and coal bunkers have a total length of 295 feet, and a railroad track, 590 feet long, conveys the coal from one to the other. The fire-room force consists of 237 men. The nineteen boilers are connected with four large smoke-stacks, each 16 feet 5 inches in diameter and 131 feet in height above the keel. The daily coal consumption amounts to 625 tons.

The main and auxiliary engines taken together number 79, with 124 steam cylinders, and the condensers contain piping amounting to a length of about forty nautical miles.

The ship's company altogether is made up of 600 persons.

An Improvement Which Prevents Waste of Illuminant

Some very wonderful experiments have been made in the electrical field, based on the property that selenium alone possesses of changing its resistance when exposed to sunlight. Some of these have been merely of scientific value, some have been merely laboratory show experiments. At last, however, this unique property of selenium has been put to practical use. Ship buoys have been manufactured for some years past which carry a supply of gas in a reservoir sufficient to last for a month, or, as in the case of the St. Lawrence range lights, for several months. The buoy lantern is lighted and allowed to burn day and night until exhausted. Ernest Ruhmer, who has devised several very extraordinary electrical appliances based on selenium's action in light, has adapted a salenium circuit maker to a Pintoch gas buoy. The selenium cell is placed in the top of such a buoy where it will be exposed to all the light there is. As the sun comes up in the morning, its rays strike the selenium cell, and thereby changes its electrical resistance, so that a sufficiently powerful current passes through a circuit in which there is an electro-magnet, thus switching off the gas, allowing only sufficient to escape through a by-pass to keep a light. When the day grows dark, as during a severe thunder storm, or during a heavy rain-storm, the electrical resistance of the selenium cell automatically changes, again turning on a full supply of gas. In effect this selenium attachment increases the capacity of a buoy for from three to five months. In dangerous locations, or where the buoys are difficult of access, the number of times it is necessary to recharge a buoy during a season, or during a year is a matter of great economical importance.

Safety Valves

It has been found in practice that the ordinary safety valve, lifting automatically, only rises very slightly in proportion to the area of the dics, and a greater lift than 1-10 inch should not be expected, unless the pressure becomes considerably increased from what it was when the valve first began to rise. The small lift is due to the rapid diminution of the force of the steam near the orifice, as the valve rises from its seat.

When it is necessary for the diameter to exceed four inches to get sufficient area, it is better to use two or more valves than increase the size.

The exact size of the safety-valve for a given boiler can only be determined by experiment. Professor Rankine gives the following rule for determining the area of safety-valves:

Multiply the number of pounds of water evaporated per hour by 0.006; the product will be the area of the valve in inches, or one-half inch area of valve to each square foot of grate surface.

To Compute the Required Area of Chimney for any Boiler

Multiply the nominal horse-power of the boiler by 112, and divide the product by the square root of the height of the chimney in feet. The quotient will be the required area in square inches. For stationary boilers, the area of the chimney should be one-fifth greater than the combined area of all the flues and tubes. For marine boilers, the general rule is to allow 14 square inches area of chimney for each nominal horse-power.

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The Value of Trade Papers.

It is only within the last few years that the potent influence of the trade journal has been felt as an educator. While there are many valuable text books upon the engineering profession, yet it is seldom that an engineer feels that he can dispense with his monthly papers. The reason of this is simple, indeed; it is through the medium of these papers that he is kept in continual touch with every phase of his profession, no matter how rapid the advancement may be or from what part of the globe it emanates. Nor is the benefits confined to the engineer alone—all ages and persons may derive substantial knowledge in reading such a paper. The child in reading may in a manner gather greater comprehension of the world's magnitude; the manufacturer, the engineer and the merchant are also brought in direct contact with every new phase of their business directly it occurs.

One of the most interesting features of the trade papers are the vast number of daily experiences cited in the correspondence columns. An idea once grasped is often improved a hundred fold, yet, without the idea in the first place, the improver would have been powerless. It is this feature of interchanging ideas that brings the trade paper so strongly to the front and we wish to strongly impress upon our readers that this paper is intended as a storehouse of knowledge which may be levied upon at the will of the reader; also, that it is a clearing-house for ideas. We want our readers to send in to us any of the multiplicity of happenings of their plant; in this manner aid others and in return be aided by others.

In addition to the material mechanical benefits derived in this way one will find that it improves the grammar, the writing and brushes up one's mathematics. Again, many engineers who ordinarily object to a set course of study will find in this manner of discussion a means of determining many points which would be otherwise lost. Again, let us impress you with the importance of earnest co-operation with us in thus disseminating amidst the many the points of value we chance upon in our daily vocation.

We invite your attention to this feature of our paper, and will assist the writer of such notes as far as lies in our power.

Back Pressure.

The question of back-pressure is usually given too little consideration by engineers. Yet this subject is worth all the attention which can be bestowed upon it; for back pressure costs money—and lots of it. For instance, we will presume that we have a 160 horse-power plant. The actual cost of the back-pressure will depend upon the size of the cylinder and the speed of the piston. It will be readily understood that for a given power the speed of the piston must increase as the sectional area of the cylinder diminishes, and if the piston speed remains the same, and an earlier cut-off is obtained, the cylinder must be larger.

We will take an engine of the side valve type, with a cylinder 12 inches in diameter, and stroke of 18 inches, running 125 revolutions per minute. Taking four-fifth of the stroke, or that portion of the return before compression begins, as the effective part of the back-pressure, we will have the piston moving 125 times two and one-third feet, or 292 feet per minute. As the area of the piston is 113 square inches, we have the piston exerting a power of 292x113, or 32.996 foot pounds of work per minute for each pound of back-pressure upon the engine. In other words, each pound of back-pressure takes off one horse-power from the effectiveness of the machine, or adds one horse-power to the constant load.

We are doing, then, one horse-power of useless work. On an econominal production of steam, with an evaporation of ten pounds of water per pound of coal, and using only thirty-two pounds of water per horse-power per hour, we have a waste of thirty-two pounds of coal per day of ten hours, or five tons a year costing $20. And as this cost increases directly with the pressure, it will cost $100 a year to support a back-pressure of five pounds. No account is here taken of water charges which will also be quite an expense in cases where the water is taken from city water works.

It must be remembered too that this expense increases with the size of the engine, and for a cylinder 20 inches in diameter would be very high.

Steam Gauge Freaks.

Engineers in piping up steam gauges very frequently make the mistake of giving too much "head" to the pipe, and in this way destroy the accuracy of the gauge.

If the steam has to sustain a column of water leading up to the gauge, the gauge will read one pound lighter for every 27.71 inches, which the column is above the hydrostatic level. In this way it may easily happen that two gauges, both correct and showing same result upon the test pump, will show a marked discrepancy when in position; this is owing to the fact that no provision has been made for a difference in the heighth of water in thin leading pipes.

"Why is the decimal .7854 used to ascertain the area of a circle or roud opening?"

Most people know that this is a constant number, and, particularly in the engineering practice it is necessary to use it quite frequently. But the very fewest in number know from whence it is derived, or just how it came to be adopted. However, if you will divide a square inch into 10,000 parts, then describe a circle one inch in diameter, and divide that into ten thousandths of an inch, you will find that you have .7854 of such squares, each one-thousandth of an inch, hence the decimal .7854 is used as a "constant" or multiplier, after squaring the diameter, and the result is the area of the circle.

Can an Engineer be a Gentleman?

Truly the question seems superfluous, yet we have at hand an instance of world-wide notoriety wherein a man because he was an engineer was excluded from participating in certain international sports with "gentlemen."

The man in question was an expert American amatuer oarsman, who applied for permission to compete for the "Diamond Sculls," at the Henley Regatta, England. It seems the gentleman was a mechanical engineer, and in the course of his studies had to become proficient with the practical as well as the theoretical branches of his profession; hence the mechanic.

In America, all men are gentlemen who act as such. In England, it seems that once a man has "stooped" to the "degradation" of earning money as a mechanic, he is put on the black-list forever—we may be thankful that we are Americans.

Who occupies higher places in the world's Hall of Fame than Watt, Trevithick, Stephenson and Ericson, mechanics all?

Who has a prouder and braver record, in a profession where all are gallent and courageous, than Rear Admiral Geo. W. Melville, U. S. N.?

Read his remarks to the graduates of a certain school for engineers:

"The engineering profession dominates the age. Owing to the fact that he is best qualified to understand and to perform the largest and most important share of the world's work, the engineer is, by a process of natual evolution, called upon to act in an administrative capacity in both public and private affairs."

And what is an engineer but a mechanic?

And yet the men who design, construct and operate the machinery which makes modern civilization possible—yes, who are, and have been, the principal factors in the world's greatness—are not worthy to compete in in English waters in a friendly contest with gentlemen (?).

The element radium (if it is an element) promises to be one of the most important substances ever discovered, even though it is exceedingly rare, and occurs only in very small quantities. It is known to continuously emit radiations capable of affecting photographic plates, and this alone would be a sufficiently remarkable attribute. It now appears, however, that radium has a far more wonderful quality; for when it is surrounded by objects of an absolutely uniform temperature, the metal itself is found to have a temperature higher than its surroundings by from 1.5° to 2.0° Fahr. This property is absolutely unprecedented, and its cause is not yet known.

What is a Right-Handed Engine.

The question, "What Is a Right-Handed Engine"? has again risen in the minds of some of our readers, and has received in the past few issues of this paper considerable comment.

Mechanicians and designers of engines in general have come to the agreement that an engine the fly-wheel of which is to the right as you look from the cylinder toward the shaft is a right-handed engine.

Usually with shaft governors, in cases of engines of the self contained type, the governor wheel is the one considered. Now in case of a pair of cylinders attached to a common shaft with a fly-wheel in the centre, we have simply the right- and left-hand cylinders of the double engine.

Now in case of engines of the cross-compound variety—say two set side by side, with the low pressure cylinders coming together so as to exhaust into the same condenser, and what will we term them? One must be right-, and one, of course, must be left-handed, but which is the right and which is the left? Probably the correct solution of the problem would be to designate them right or left, according to the position of the high-pressure cylinder. That is having the high pressure cylinder to the right when looking between the cylinders toward the shaft in case of right-hand engines, and the one with opposite arrangement may be termed left-handed.

There should be some general, or universal, rule concerning this subject, and we know of no better definition than the above.

In connecting an Injector always take steam from the highest point, " the dome if possible," and under no circumstances connect into a steam pipe furnishing steam for other purposes. Every engineer well knows that when steam is feeding an engine or pump that it pulsates, besides using the life of the steam, the injector *must* get its steam pressure steady and constant and with all the life there is in it.

Noon Hour in Powers Mill

Part III.

By A. Edward Rhodes.

I guess that nex time me an the kid tells Mr. P. that the machin'ry of this mill needs fixin he'll think mabe we know when things will go smash if they ain't fixed to once. Say, you oughter see Mr. P. when I told him that old biler No. 3 is a leakin fit to blow sky high, an I had ordered Jim to draw her fire outer of her quickerin litenin. An to break the news to him, softly like, about Sally (the 8x10 vertical engine that runs the East mill) runnin away, I told him you know accidents kinder comes in heaps, says I to Mr. P., and he says to me, kinder cross like, Dick what the thunder do you mean? No morilizin now, but come to the point at once say's he, what else happened says he, gettin excited. An I see I dassant say much but I wanted fur him to know it was his fault fur not gittin us a new belt, so I says kinder eaisy like. Oh, nothin much, only that there old gov'ner belt, what me an the kid was atellin ye was blaid out, went ker-slap to pieces an in course, as was to be expected, the ingine run away afore I could git her stopped, she was a runnin purty fast an some pullies is busted an I guess some shafts is out of plum. It jist happened an the kid said as how I'd best for to tell you an git orders to shut down the East mill to-day till repairs is made, an if you'd a ordered a new gov'ner belt, as how I wanted you to says I, you'd a saved considerable, an then I started out but he called me back, Mr. P. did, an he says to me. Dick you go out to the machine shop an tell Mr. Goodfit to send men over an have the mill in shape to start up as soon as he can, an Dick you had best test every biler in the East mill by hyderstatic pressure.

It was during the testing of these boilers that someone, I have forgotten who, asked, "Is the strain of a boiler the same when tested with hydrostatic pressure, as when tested with steam pressure?" In reply to which the kid held forth as follows:

All new boilers, and all boilers that have been extensively repaired, must be subjected to hydrostatic pressure in excess of the highest working pressure, in order to test the tightness of the seams and rivits, the soundness of the plates and the structural strength of the boilers. Such tests must be repeated periodically during the lifetime of the boiler. A test pressure equal to three times the working pressure was formerly held necessary by the authorities, but nowadays it is not considered prudent to subject boilers of the ordinary form to so severe a test. An excessive pressure may produce injuries which do not become apparent during the short test, but which continue to increase under the ordinary working pressure when the boiler is put into regular use. The test pressure must in no case strain any part of the boiler beyond the limit of elasticity of the metal. An old copy of the Revised Statutes of the United States, that was loaned to me, provides that all boilers used on steam vessels shall be inspected and subjected to a hydrostatic test in the ration of 150 pounds to the square inch to 100 pounds to the square inch working steam pressure allowed. United States naval boilers, when new or extensively repaired, are also subjected to a test pressure equal to one and a half times the working pressure above the atmospheric pressure. French laws require that tubular boilers of merchant vessels are to be tested to double the working pressure above the atmosphere at least once a year, and whenever repairs or alterations have been made to them. The boilers of French naval vessels are subjected, when new, to a test pressure equal to twice the working pressure, and annually thereafter to a test of one and a half times the actual working pressure above the atmosphere; but this pressure is to be kept on the boiler not longer than five minutes. The English Admiralty, 1879, issued the following instructions regarding periodical testing by water pressure of the boilers of Her Majestys ships and vessels in commission. In the case of ships having new boilers, or boilers repaired for a commission of four years, the boilers are to be tested by water pressure at the end of two years service, and subsequently at half yearly intervals during the remainder of the commission. During the application of water pressure the boilers are to be carefully examined, and proper gauges are to be used to detect any change in the form of the furnaces, combustion chambers, etc. The water pressure is to be double the working pressure, provided that during the examination no indications of weakness are observed. Should, however, any indication of probable permanent deformation be observed, the test is to cease, and the working pressure is then to be limited to one-third that of the test pressure arrived at before such indications were seen.

The English Board of Trade requires all new boilers, and all boilers that have been extensively repaired, must be tested by hydrostatic pressure up to at least double the working pressure that will be allowed. Said test to be made before boiler is placed, or replaced, in position, to test workmanship, etc., but the working pressure is to be determined by the stay power, thickness of plates, and strength of riveting, etc.

This brings us to HOW TO TEST BOILERS. The usual method of testing boilers is to fill them with water and produce pressure within them by means of a small hand force pump. All openings of the boiler are securely closed. The safety valve, which is loaded to the required test pressure, is kept raised until the boiler is completely filled with water. Then, after closing the safety-valve, the pump is worked until the steam gauge indicates the test pressure. The pump should deliver only a small quantity of water at each stroke, and must be worked carefully, as the pressure rises, in order to avoid jarring the strained boiler and producing a sudden rise of pressure beyond the limit of the test pressure. Some engineers close the safety-valve before the boiler is quite full of water, and so retain a quantity of air to act as a cushion when the pressure is applied to the pump. Personally, I do not approve of so doing, because, when this enclosed air escapes through leaky seams and rivits, no marks indicating such leaks are indicated on the plates. Whereas water will leave a mark, and a little more care only need be exercised when working the pump. When boilers are tested by hydrostatic pressure, the water should always be hot. There is no difference in pressure between hydrostatic and steam tests, neither is there any question as to which one offers the better opportunity for realizing on an accident policy.

A new source of danger in train accidents was made evident in the Tucson collision, on the Southern Pacific. Both locomotives burned fuel oil and the force of the collision broke open the oil tanks and the oil ran down the gutter beside the track, was set on fire, and converted the whole wreck almost immediately into a mass of flame. Any railway officer would

apprehend at once the danger of hauling an oil tank car in a passenger train; but a tender tank filled with oil may be quite as fatal a companion in a wreck. In view of the complaints made of oil in passenger service on account of the injury to the varnish of cars and the general dirtiness, together with the danger now apparent in case of accident, it seems open to question at least whether it is wise to burn oil on passenger locomotives.

Why Dynamos Sometimes Fail to Generate Current

There may be numerous causes for such an occurence. First, the residual magnetism in the field magnets of the dynamo may be too weak. Series of dynamos can be stared in such a case when running at normal speed, by short-circuiting the binding posts with a piece of wire for a fraction of a second; if short-circuited too long, serious damage may be done to the commutator. This operation cannot be applied to shunt dynamos, as they will not generate any current when the binding posts of the machine or the outgoing wires are short-circuited. In order to start shunt dynamos, the external circuit must be disconnected from the dynamo, and after the dynamo has been running at normal speed for about a minute, the external circuit must be suddenly thrown on the dynamo.

Secondly, poor contacts may be the cause. Every connection of the armature and the magnets should be closely inspected. If necessary the contacts should be cleaned and set screws tightened.

Thirdly, the insulation of the building post and the brush holders may be in poor condition. For instance, if the metal bars of the brush holders should touch the quadrant, the armature would be short-circuited and no current would be generated. Such faults can be very easily detected by means of the detector galvanometer.

Fourthly, if one or more field magnets are short-circuited the dynamo will generate current, but the current will not be at normal strength. In this case the dynamo should be examined.

Fifthly, shunt dynamos, as mentioned heretofore, will not generate any current when short-circuited. This is especially true for small dynamos. In incandescent lamp installation, for instance, it may happen that two branch wires or two contact points in a lamp holder, are short-circuited. Even as trivial a fault as this may be sufficient to prevent the dynamo from generating any current at all. By taking out one of the circuit wires and putting an incandescent lamp between the binding posts of the dynamo, it can be very easily discovered whether the fault is in the dynamo or in the external circuit. If the lamp burns properly, the fault is in the circuit. If it does not burn properly, the fault is in the dynamo. If the fault should be in the circuit, insert the circuit wire suddenly in the binding post, and the short-circuit will show either by burning out or by fusing a safety plug. Great care should be taken in making this test not to set the building on fire, as considerable sparking and often meling of a small wire may be caused in the place where the short-circuit is. If the short-circuit should be heavy, the probability is that the belt will fly off the dynamo pulley. In such a case the short-circuit will be located by means of the detector galvanometer. It is advisable to watch the belt before inserting the wire in the binding post, in order that it may not be injured by being thrown off. If the belt on the dynamo pulley commences to squeak and the lamp between the binding posts commences to burn dimly, the wire should be pulled quickly back again, and this operation not carried any further, but the fault should be located by means of the galvanometer.

The Action of Superheated Steam Upon the Component Parts of Engines

The problem of generating and using superheated steam has become a question with which the present day engineer has to contend; and a question which has already occupied the minds of mechanicians along the line of steam engineering, with considerable economy resulting therefrom.

It will be understood that superheated steam is generated by the addition of heat to saturated steam. In the behavior of superheated steam we find the same conditions existing as prevail in the use of gases of any other type; it is a very poor conductor of heat and also possesses the peculiarity in that it can afford to lose quite a number of heat units without becoming saturated steam. The thermal capacity of steam is only 0.48, therefore very little heat is required to superheat steam; but as the steam loses the heat almost as readily as it acquires it we can readily see that all passeges leading to or from the heater should be well covered with the best quality of non-conducting material.

Of course there are radiation losses when using the superheated product, yet these are very much less because the loss of heat from the superheated steam has lower calorifie value than the latent heat of saturated steam. Superheated steam has a greater volume per unit of weight than saturated steam at the same pressure, hence one advantage, and the higher the temperature, the greater this advantage. At various pressures and temperatures the increase of volume may be taken from the following Table I:

Pressure	390 deg. F.	570 deg. F.	750 deg. F.
70	1.1	1.33	1.57
115	1.06	1.29	1.52
170	1.02	1.24	1.46

Table I shows that the higher the pressure is, the smaller the increase of volume; and it is proved from practice that the advantage with lower pressure is indeed greater in proportion than with higher pressure.

The question may arise whether the increase of volume does not require more additional heat that the benefit derived from it is worth. To show this clearly, Table II has been prepared, expressing how many B. T. U. less are required to produce one cubic foot of superheated steam than of saturated steam at the same pressure. For various pressures and temperatures the total heat per cubic foot is as follows:

Pressure	Saturated	390 deg. F.	570 deg. F.	750 deg. F.
70	233	219	192	175
115	350	337	297	267
170	492	485	432	398

i. e., to produce, for example, one cubic foot of steam at 115lb. pressure and a temperature of 570 deg. F.,

$$350-297\times350=15 \text{ p.c.}$$

less heat is required than to produce one cubic foot of saturated steam at the same pressure. With saturated steam engines 20 to 25 per cent. of admitted steam is condensed during the admission period, consequently the practical steam consumption is very much in excess of the theoretical. Superheated

steam does not condense during this period if sufficiently superheated, hence another advantage.

The economy effected by using superheated steam in engines is very remakable, and, acknowledging this fact, a great number of steam users all over the world superheat the steam, although in many cases only a few degrees, yet a considerable saving in coal and steam is always the result. To obtain the full benefit the required temperature of steam is 660 deg. to 700 deg. F., and to stand this temperature the engines must be specially designed. It is not sufficient to use mineral oil with a very high flash point.

The introduction of superheated steam largely influences the expansion of the heated parts. Engines always gave great trouble when the distribution of metal in the cylinders was not uniform, as parts with more metal expanded most, and forced the cylinder walls towards the inside and made the cylinder out of shape. When using liners in the cylinders, they were squeezed in at the ends, decreasing the diameter, and jamming the piston body if sufficient clearance was not provided. With steam jackets heated with steam of 500 deg. F. the lubrication ceased as the cylinder walls became too much heated, subsequently it was found necessary to do away with jackets, or if jackets were already provided, not to pass steam through them. Pistons constructed on the Ramsbottom type always worked satisfactorily, except where fitted with steel springs when they came in contact with highly superheated steam. Any kind of gun-metal gets brittle after a very short time, therefore valves, seats, and all parts coming in contact with the superheated steam should be of cast iron or other suitable material. Copper also losses about 40 per cent. of its strength at such high temperature, consequently the use of copper bends becomes impracticable. The best material for piping has proved to be wrought iron and steel, each pipe being as long as possible and with the least number of flanges that can be done with. In case of long straight runs of pipe care should be exercised in providing proper expansion room, which is at 700 degrees F. about 0.0037 of the length of the pipe; hence for example, 100 foot of pipe will extend 0.37 of a foot, nearly 4½ inches.

It is advisable to place the stuffing box as far as possible from the cylinder end to keep it well away from the hottest parts, and to allow of as much radiation as possible. Sufficient clearance in the neck bush should be allowed for the expansion of the piston rod, and care should be exercised so as to use no metal with a fusing point below that of the steam.

Valves and valve gears should be selected with the same care, as they are equally susceptible to high temperatures. Valves containing many ribs or different thicknesses of metal (in sections), such as Corliss valves of the usual construction, are not suitable for high temperatures. A Corliss valve of medium size will stand 480 degrees to 500 degrees F., but no more, and the latter temperature very seldom. The smaller the plain slide valves are the better they will stand the high temperatures. Large slide valves will not stand any appreciable degree of superheating without having a system of forced oil feed.

Piston valves have proved to be most suitable for the highest temperature, owing to their uniform distribution of metal. With ground valves the ribs holding the boss for the spindle must not begin within the working surface of the valve, but have to be placed beyond that, because they expand and tend to make the valve polygonal. The valves also must be ground in other liners to those in which they are to work in the engine; the former lines have to be smaller in diameter to secure more clearance to provide for the expansion of the valves; all ribs must be placed beyond the working surface of the valve.

The cylinder expands in length more or less than the steam chest, causing thereby deformation of the latter, which must be carefully considered in design. It is best to work the valves in liners fixed in the cylinder and with a small clearance, sufficient to allow for the deformation of the steam-chest. With this construction is it of course necessary to make steam-tight joints between the several ports, and this is best done by stepping the liners and seats and using narrow asbestos rings for each step. The liner is then forced on to the small seats by set screws in the cover, these asbestos rings making a lasting joint. Long valves cast in one piece becomes scored, whether they are cooled from inside with exhaust steam or not, consequently all valves should be made as short as possible. Rings and springs in valves cannot be recommended, as the steam comes behind the rings and increases the pressure, causing friction, and therefore increased oil consumption. As it is impossible to rely on tightness of piston valves, they must be made as small in diameter as possible. It may be stated here that superheated steam can travel at 30 to 40 per cent. higher speed through steam ports than saturated steam, and this fact has to be considered during construction. The piston valves working one in the other, as the Rider or Meyer valves, are impracticable for superheated steam. If engines of that type are intended to be worked with superheated steam, each valve must work in a separate chamber. Double-beat valves can also be recommended as being safe, but they require a special arrangement, which is not always obtainable with every gear. Very often it happens when warming up the engines that the valve spindles get hotter than the gland boxes, and on starting the engine the friction between spindle and stuffing box is greater than the power of the spring, and if the valves are not positively driven, they remain open during the full stroke.

An engine constructed in accordance with the principles just explained, is as safe with superheated steam as any other engine with saturated steam. From the experience over several years, it is not necessary to be bound to single acting engines. Besides the economy, the use of highly superheated steam has some other advantages which are also important. It makes the steam consumption nearly independent of the size of engine, as a small engine has about the same steam consumption as a larger one; as for example, an 80-h. p. compound condensing engine uses 10.45lb. of steam at 160lb. pressure, and a 1,000-h.p. engine uses 9lb. of steam per indicated horse-power per hour. The use of highly superheated steam does not require high poiler pressures—160lb. is the highest to be recommended, as no advantage can be derived by exceeding this. As the amount of heat transmitted from the steam to cylinder walls, and *vice versa*, is much lower with superheated steam than with saturated steam, the whole range of temperature from boiler pressure to vacuum can take place in one or two cylinders, so that the use of a triple expansion engine does not make the slightest improvement in economy. It is not intended to be understood that the author proposes to do away with all triple-expansion engines for very large plants; their use will be necessary for constructive reasons.

With regard to economy obtained from engines working with superheated steam, the gain is derived from the

larger volume of steam and the doing away with initial condensation. Generally the steam consumption of modern engines working under good conditions may be taken as follows: Single cylinder condensing engines, with saturated steam and a pressure of 90lb. to 100lb. per square inch, use 19lb. to 25lb. of steam per indicated horse-power per hour, corresponding to 373 to 490 B. T. U. per minute. The great difference in temperature between admission and exhaust steam causes much waste by initial condensation, and consequently this type of engine especially favors the use of superheated steam. With superheated steam the consumption has been lowered to 13½lb. and 15lb. corresponding to 290 to 335 B. T. U. Non condensing single-cylinder engines gave consumptions, of 15lb. to 18lb. of steam per indicated horse-power per hour, which is about the same consumption as an average compound condensing engine with saturated steam. The non-condensing compound engine decreases the consumption to 14lb. and 16lb. per indicated horse-power per hour. The compound condensing engine is the most economical, and the economy obtained can hardly be reached by a quadruple-expansion engine working at a pressure of 300lb. The steam consumption of such an engine either compound or tandem, at 140lb. pressure only, never exceed 10 pound per indicated horse-power per hour, and usually remains below, many tests having proved 8.5 pounds and 8.8 pounds consumption per indicated horse-power. To utilize better these temperatures, and to work with various loads with safety and nearly uniform economy, Mr. Schmidt has introduced the receiver heater with automatic valve.

The idea is to keep a steady mean temperature of cylinder walls not higher than will make the means of lubrication unreliable for the different existing expansions. In view of the great advantages of steam superheating, and the great number of engines now using it satisfactorily, it is astonishing the amount of prejudice with which its introduction is viewed by a great many engineers. It will be worth mentioning the great majority of tests of superheated steam has demonstrated a great saving in steam and coal.

Coal Briquetting

The briquetting of coal dust, which heretofore has been a waste product, is now coming to be quite general. This, it has been proved, can be done profitably in sections where coal is scarce—for instance the San Francisco and San Joaquin Coal Co., San Francisco, Cal., are installing coal briquetting machinery with the intention of putting into marketable shape not only their own waste dust, but will prepare the same for other yards.

The plant is to be electrically driven throughout, the motors being arranged to give any desired speed from 20 R. P. M. to 550 R. P. M. in about fifteen steps. Two 40-Horse-power, slow speed, 500-volt, direct-current motors have recently been purchased for this purpose from the Westinghouse Electric & Mfg. Co., together with speed controlling rheostats designed to vary the speed of the motors within the above limits. The controllers will allow the motors to be operated continuously at any of the speeds.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Chemistry of Combustion

Editor THE PRACTICAL ENGINEER;

Although many engineers are of the opinion that they should not be expected to be chemists in a certain sense, there are others who find profit both to themselves and their employers by familiarizing themselves with chemical action. Such as pertain to the steam plant, at least.

The chemistry of combustion, although a subject that has claimed the attention of engineers for years, and has also been treated upon by different writers is still a subject of interest to the majority of our profession.

It is well to inquire first into the chemical combination that must take place before combustion can occur.

Elementary chemical substances are those that have not been decomposed; for example, oxygen, hydrogen, and nitrogen. The elements entering into chemical combination in fixed proportions by weight, or the atomic weight of the elements. The atomic weight of any element may be found by dividing the weight of a given volume, when in a gaseous state, by the weight of a like volume of hydrogen.

With the atomic weight of the following elements, the composition of any substance, by weight, may be found when its symbol is known. The weight of carbon (C) being 12; hydrogen (H), 1; oxygen (O), 16; nitrogen (N), 14; and sulphur (S), 12. For example: Carbon dioxide CO, contains one atom of carbon, which, times it atomic weight 12, equals 12 parts by weight of C. Two atoms of O, times its weight-16, equals 2x16, or 32 parts by weight; and 32—12, equals 44 parts by weight of CO.

In order to obtain combustion, a chemical action must take place between two or more elements. Therefore, combustion is the rapid chemical combination of either carbon or hydrogen (or both); with oxygen.

The question may properly be asked:—Why does the combining of the two or more elements mentioned, produce combustion? We know that combustion does occur; but just what the action of the atoms of each element is may not be so readily understood. The atoms of some of the elements have a strong attraction for those of other elements, and when they combine, they rush together with great rapidity and force. It is the rapid movements of these atoms that cause combustion; as when oxygen and carbon combine at a sufficiently high temperature, they combine with great rapidity; and when the combination is rapid enough to raise the temperature to a certain point, combustion ensues. To understand more fully the action of these atoms, visit the forge of some convenient blacksmith shop and measure a square bar of iron when cold; then measure it again when it becomes a cherry red;

It will be found at the second measurement that it is slightly larger than before, although no motion is discernible. Continue the heating process, and soon small particles of the iron bar will be seen to shoot away from it; and, at a white heat, countless small portions will be seen to shoot out in all directions; in fact, the motion is so rapid that a sound is quite audible. The cause of these sparks is simply because the motion of the atoms of the iron is so rapid by reason of the intense heat of the forge fire, that move out beyond the limit of their attraction for each other; and, upon measuring the bar again, it will be found to be considerably larger than at first. These rapid movements develop a heat which increases as the motion of the atoms increases; and, if the motion becomes rapid enough, the bar will be consumed because of combustion. This same principle applies to the combustion of all kinds of fuels, the greatest percentage of which is carbon.

When fuel is placed upon the grates of a furnace, there can be no combustion until the combination of oxygen and carbon has been so rapid that sufficient heat has been produced to cause combustion.

The reason that the match is ignited, is because the friction against the phosphorus, as it is rubbed across some rough surface, is enough to raise the temperature to such a degree that the atoms are given a rapid movement, and a combination is made with the oxygen of the air, which in turn is so rapid that a great heat is given out, and combustion takes place; this is communicated to the wood of the match which applies the heat to the fuel upon the grates.

Although the fuel upon the grates may burn brightly, there is considerable doubt about the combustion being as complete as is desirable. In fact, this perfection is never reached in practice, at all times.

In the process of combustion, two gases are formed. If the air supplied to the burning fuel is insufficient, a gas is formed, and the carbon igniting with one portion of oxygen, produces carbon mouoxide CO. Another gas may be formed by the carbon uniting with two portions of oxygen, and is known as carbon dioxide CO_2.

It has been found by experiments that the heat of combustion of carbon burned to CO_2, is equal to about 14,600 B. T. U. (British Thermal Units); and when burned to CO, gives about 4,400 B. T. U. So it will be seen that carbon burned to CO_2, or complete combustion, gives more than three times the heat obtained from incomplete combustion to CO.

This is a matter that may well engage the attention of all who are interested in the economical use of fuel, and readily points out why one man can do a certain amount of work with less fuel,—all conditions being the same—than another.

Several conditions govern the economical combustion of fuel, and undoubtedly the chief consideration is the air supply. As it is impossible to obtain complete combustion with 12 pounds of air, the theoretical amount (since carbon burned to CO_2 requires two parts of oxygen), therefore, one pound of carbon requires $\frac{2\times 16}{12}=2\frac{2}{3}$ pounds of oxygen. For rough calculation, we may consider that the atmosphere is made up of one volume of oxygen and four volumes of nitrogen; therefore, in order to obtain one pound of oxygen, we must take one volume of oxygen, 16, and four volumes of nitrogen weighing 14; making $(16\times4\times14)\div16=4\frac{1}{2}$ pounds of air—nearly. As one pound of carbon requires $2\frac{2}{3}$ pounds of oxygen, it is evident that a pound of carbon will require $2\frac{2}{3}\times4\frac{1}{2}=12$ pounds of air—nearly. As it is not possible to obtain complete combustion with 12 pounds of air, it becomes necessary to supply an excess of air which varies from 18 to 24 pounds of air instead of 12 pounds. This is necessary because the air is obliged to pass through the bed of coal, which prevents it from coming into direct contact with the burning surface of the fuel to produce perfect combustion.

The losses from incomplete combustion are far in excess of what they are in the prevailing opinion among engineers and firemen, and they are well worth investigating. The presence of even a small amount of carbon in the flue gases is evidence of an appreciable loss of efficiency, as we shall endeavor to make plain in the following:

From a test made on a large boiler, it was found that when the flue gases were burned to CO_2, they contained 75 parts of carbon, and when burned to CO contained 6.6 parts of carbon. We have stated that one pound of carbon burnt to CO_2, will give about 14,600 B. T. U.; we have, then, $75\times14,600=1,095,000$ B. T. U.; and 6.6 parts of carbon burned to CO, gives $6.6\times4,400=29,040$ B. T. U., or a total of $1,095,000+29,040=1,124,040$ B. T. U. Supposing that the carbon had been burned to CO, we should have had $(75+6.6)\times14,600=1,191,360$ B. T. U. The loss by incomplete combustion was, therefore, $\frac{1191890-1124040}{1191860}\times100=5.6$ per cent. This is a trifle in excess, as less air is required to burn carbon to CO than to CO_2. While it is certain that too little air admitted to the furnace is a source of loss through incomplete combustion, it is just as certain that too great an amount of air, will also cause a loss, as the extra amount more than is required to produce combustion is simply a carrier of heat from the furnace to the stack.

According to the above, it is quite evident that there is room for experiment on the part of every engineer and fireman. He may think that the combustion of his fuel is as near perfect as is possible, but undoubtedly a little more experimenting along the line of admitting air to the furnace in the right quantity, will demonstrate that there is still room for improvement. The ideal condition, as required for perfect combustion is far from maturing in the majority of steam plants. It is, therefore, a problem to be determined by experience as to how much air shall be admitted to the furnace to produce the most economical rate of combustion.

I. M. Spry.

Trouble with a Buckeye Engine

Editor Practical Engineer:

Constant Reader wants to know the cause of his trouble with a Buckeye engine.

The cause of the racing of your governor at no load is very probably due to over tension of the governor springs. If you will reduce the spring tension a little and move the spring clips toward the weights enough to maintain the same speed, I think the racing will cease.

Make sure there is no sticky or gummed joints or excessive friction in the working parts of the governor or eccentric. The clicking noise may be due to a loose connection where the cut-off valve stem is screwed in or to improperly seated cut-off valve.

The only proper way to set the valves of engines is by the use of the Steam Engine Indicator, which will show the necessary changes to make.

However, when the Indicator cannot be had the best way to guess at the valve setting is as follows:

Remove the steam chest cover and balance ring plates. Marks will be found showing the ports in the valve and cylinder by which the valve travel may be equalized, and the lead may be noted at this point by placing the engine on dead ceter; give the valve about 1-16″ lead. The main eccentric is moved by loosening the clamp nuts found on the side of the eccentric and driving the wedge bolt back; then turn the eccentric to the desired position, make fast by tightening the clamp nuts. The cut-off valve may be equalized by looking through the balance ring holes. Turn the engine until the crank end of the valve has cut off, then measure on the guides from the end of travel to position of cross-head (having a fixed point on the cross-head to measure from), then turn the engine over to the head end until the cut-off valve is closed and measure on the guides. Add the two measurements taken from the guides and divide by 2. This will give the distance at which each end should cut off. Move the cross-head to the distance found. Then by changing the valve connection, bring the valve to the point of closure, then try the other end and if cut-off is equal, make valve connection fast. In sitting the cut-off valve block the governor levers half way out.

A series wound dynamo is one whose field winders are in series with the line, and which is excited by the current passing through the lines.

A compound wound dynamo is one whose field is excited by a slunt winding, and over the slunt winding is a series winding, having only a few turns of wire around each magnet. As the current of the line increases the series winding increases the strength of the magnets which maintains the same voltage at all loads, or may be over compounded so as to increase the voltage as the load increases.

C. B. RISLEY.

A Novel Method of Cleaning Drains

Editor Practical Engineer:

To me your engineers' letter columns is always a source of information and interest, containing, as they do, practical points upon practical subjects. I herewith send you a description of a method which I have found efficacious in removing grease from sewer pipes or drain pipes of any type.

In hotels, or large institutions of like nature there is always a great amount of greasey matter running to the sewers from the kitchen pantries. So much so in fact that it is very hard to keep such pipes clean at all.

Where I am now working my predecessor had punched holes in the top of a six inch drain pipe in order that a wire might be inserted to dislodge the grease accumulations. But to me such a method seemed so cumbersome that I had a plumber put in a new drain pipe and inserted traps at intervals which were so arranged as to permit access to the length of pipe between traps. These traps I found to do very well but the pipes stopped so often that the work of clearing them was not only a nasty job but took considerable time. Finally it occured to me that by using a steam hose and thoroughly heating the pipes I could melt off the grease much easier than I could scrape it off. Our application of the steam did more than all the scraping ever had accomplished. Now, all I have to do is to use the steam hose and the pipes cleans up very nicely, and with but little trouble.

PETER HARDMAN.

Frank Rose's Draft Fan

Editor Practical Engineer:

I wish to express my opinion of Frank Rose's draft fan.

The intensity of draft depends upon the difference of temperature between the escaping gases and the air entering the ashpit.

It is plain to see that in the arrangement Mr. Rose illustrates in "July issue", cold air would be discharged into the stack, which would reduce the temperature of the escaping gases, and in my opinion would do more harm than good; and I differ with the Editor in his answer to the question, for I doubt if this would result in benefit. The fan is too small to discharge a sufficient amount of air into the ashpit for a boiler of any ordinary size. I believe the best thing Mr. Rose can do with a fan of the size mentioned, would be to connect the suction by means of a pipe,so as to take a portion of the flue gases from the lower portion of the smoke box in front of the boiler, say about the lower row of tubes, and discharge these gases in the stack as shown in his sketch; except that he put a number of discharged tubes, arranged so as to distribute the blast more uniform in the stack, instead of one large opening.

C. B. RISLEY.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Editor Practical Engineer:

Will you kindly answer the following queries viz:—show a theoretical card from a high grade automatic cut-off engine 14″ by 36″, making 90 revolutions per minute, and cutting off at one-quarter stroke?

Give horse-power with a few explanations about how it is found?

How do you determine the size of the exhaust and steam ports?

What is the effect of a balanced crank on the crank pin?

What size feed pump would be required to supply the necessary water for the above mentioned engine?

LOUIS BRODEUR.

The important and essential knowledge to be derived from a careful investigation and study of indicator diagrams is invaluable to the engineer, as they enable him to ascertain and establish various facts concerning the use of steam, that by any other method would prove complicated and unsatisfactory, of which the following may be stated:

First. It shows whether the valves of an engine are correctly and evenly timed; and also serves as a guide in all necessary adjustments of the same that may be required, in order to insure the best distribution of the steam working within the cylinder;

and thereby securing the maximum economy and efficiency of the engine.

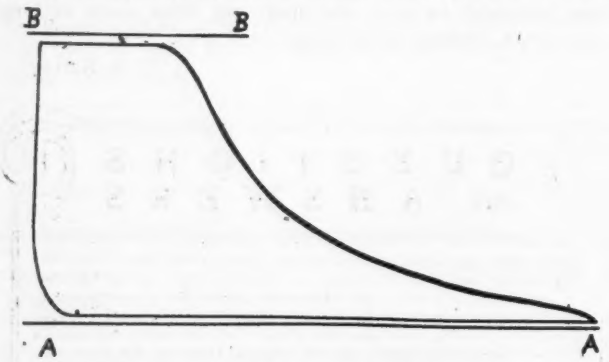
Second. The indicator power developed in the cylinder of an engine, may be determined; also the quantity of power lost in various ways; such as leakage of valves, back pressure, too early release, and incorrect adjustment of valves.

Third. It indicates whether the steam, ports, and passages, are adequate in size, and the diagram taken from the steam chest will also show whether the steam pipe and its connections are of sufficient size.

Fourth. It indicates the condition of the valves and piston in reference to leakage.

Fifth. In connection with the feed water test (showing the actual amount of water consumed), the economy with which the engine works may be determined.

To ascertain with accuracy, each and every item of information here mentioned, it is absolutely essential that the diagram should truly represent the motion of the piston, and also the pressure exerted on both sides of it at every point of its stroke.



The general features of a diagram, that indicates a proper distribution of the steam in an engine cylinder, is represented in figure one, the attainment of which (as near as possible) should be the endeavor of an engineer in setting the valves of his engine. A A is the atmosphere line, and B. B. represents the boiler pressure.

In this diagram the initial steam pressure, which is the highest pressure realized in the cylinder, is fully maintained up to the commencement of cut-off, indicating ample size of steam pipes and passages in the engine.

The expansion curve is good, and the release of the steam is sufficiently early to secure a free exhaust, also low, and uniform back pressure.

The exhaust valve closes on the return stroke in time to provide the necessary compression, or cusion, and thereby counteracting in part the effect of inertia and momentum of the piston, cross-head and reciprocating parts at the end of the stroke.

The admission of steam takes place promptly, and projects the admission line to initial pressure at right angles, or perpendicular, to the atmospheric line. These qualities being an especial requisite to insure an economical working engine.

In practice, however, there will be a great difference in the outline and appearance of the cards taken from different engines, and from the same engine at different loads.

The diagram, as stated before, simply indicates the pressure of the steam at the different stages of the stroke, and from this it is in the province of the engineer to arrive at his own conclusions concerning whether the distribution of steam is correct at every point, and, if not so, to determine wherein the fault lies and the means of remedying it. In determining the horse-power from a diagram, it is first necessary to find the average pressure in the cylinder during the entire stroke; having this, we proceed as follows:—multiply the average pressure by the area of the piston, then multiply this product by the piston speed in feet per minute, divide this by 3,3000 (the number of pounds raised one foot high one minute).

In your case you did not quote us your boiler pressure, but we will assume that it is 90 pounds, thus we have an average pressure of 60 pounds at full load; hence, 60 multiplied by 153.94 (area of piston), multiplied by 540 (speed of piston in feet per minute), divided by 33,000, equals 151.12—horse-power of your engine.

There is a regular table devised from actual practice in determining the size of steam ports and exhaust ports which may be found in almost any of the leading books upon engineering; in your case, with a cylinder diameter of 14″, the steam port area 12.556″ and the exhaust port area of 19.635″.

The reason for balancing a crank is simply to equalize, by counterweighting the shaft, the effect caused by the throw of the crank. There is no special effect upon the pin. The water consumption of an engine of this type is about 650 gallons per hour. In procuring a pump you may add 25% to this to secure adequate supply.

Editor Practical Engineer;

Please inform me through your journal the following:

Some engineers say that a Corliss engine cannot work without the dash-pots. We have one Corliss engine which has been giving us trouble. The trouble is that the steam valve does'nt always lift the dash-pot, and when it lifts the dash-pot doesn't drop. I made a valve with which I regulate the steam, and the engine is working without the dash-pots. Please explain to me why a corliss engine cannot work without the dash-pots.

J. S. Perry,
Hilo Hawaii Islands.

There is no reason why a Corliss engine should not operate without the use of dash-pots. The dash-pot is usually provided on engines because it provides a means of obtaining a quick cut-off with a minimum amount of friction. There are, however, upon the market, Corliss engines, the valves of which are operated by springs of different types and also weights. In fact, anything ensuring the movement of the valves will answer. Experience has proved that the vacuum dash-pot operates with the most positive and economical action.—[Ed.]

Editor Practical Engineer:

I have a duplex pump of the outside packed water-plungers style, which I use to feed my boiler with and it workes in a peculiar manner. I have to use three or four pints of cylinder oil every twenty-four hours to make it run somewhat easy and steady and if it don't get the oil in abundance, it seems to stick; it takes a great amount of steam to start it. When it starts it runs in jerks, and will not run steady. It will go for three or four strokes and then will stop. So it keeps me a guessing whether the piston rings are too tight or whether they are too lose and the steam blows through around them. The size of the pump is $4\frac{1}{2} \times 2\frac{3}{4} \times 4$.

I have examined the cylinders and they are in good shape and also the pistons seems to be in good shape. So I ask of you some information through your question and answer column of the Practical Engineer. F. M.

Vineland, N. J.

It is likely that your pump is of the piston valve type, and it may be rusted up somewhat; the quantity of oil used would indicate this. But the trouble probably results from using poor quality of oil and very wet steam. Try covering your steam pipe to the pump and change your oil.—EDITOR.

Editor Practical Engineer:

If steam is not super-heated, is it then termed saturated steam?

I am told that saturated steam and water coming from the same boiler are the same temperature; if so, why is it possible for a fossile plug to melt as soon as the water recedes from it?

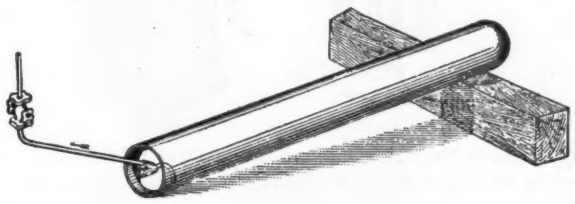
A. F. S.

1st. It is termed saturated steam. 2d. The water in a boiler will only attain a certain temperature, no matter how much heat you may apply, but steam will become heated to any degree according to the amount of heat applied. If you will consult the question and answer column of the April, 1903, number of the Practical Engineer, you will find further information on this subject.—EDITOR.

Editor Practical Engineer:

Will you please give me a few pointers upon the method of charging a freezing system with ammonia. C. H. M.

The position of the tank should be as that shown in the accompanying cut, the outlet valve pointing upwards and the other end of the tank raised 12″ to 15″. The connection between the outlet valve of the tank and the inlet cock of the system should be a ⅜″ pipe. In charging, open the valve of the tank cautiously in order to test connection; if this is tight,



open the valve fully, then start machine and run slowly until the tank is empty.

The tank is very nearly empty when frost begins to appear upon it; run the machine until the suction gauge reaches atmospheric pressure. If it holds at this pressure when the machine is stopped, the tank is empty; if not, start up again. In disconnecting, close the valve on the tank first, then the inlet cock of the system. Always weigh the tank before and after emptying; each standard tank contains from 100 to 110 pounds of ammonia.—EDITOR.

Editor Practical Engineer:

I think your reply to W. J. J.'s question, in July number of the ENGINEER, in regard to the lifting of water in the mine, is not quite clear to a great many of our readers. My line of reasoning is, that the nearer the center of the earth the greater the pressure of the atmosphere. Properly speaking, there is no such word as suction; the pump nearly exhausts the air in the suction pipe, and the pressure of the outside air forces the water up. If the pressure of the outside air is increased, which is the case in the lower part of the mine, the higher the water will be forced up the suction pipe; or, in other words, the higher the pump can be placed above the surface of the water. This explains why water can be lifted higher in the suction pipe at the bottom of the mine than at the top or sea-level.

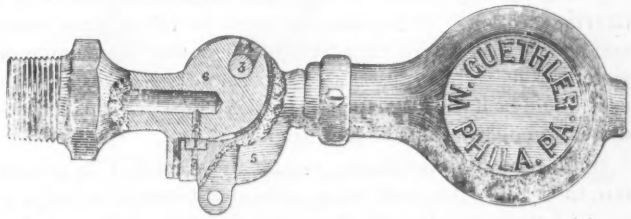
In regard to question 8, I think this is usually taken as the deck of suction-valves.

CHARLES G. TAYLOR.

The material difference gained in excess of atmospheric pressure is too small to be considered in the matter of placing pumps in mines. At sea level we have the well known pressure of the atmosphere 14.7 lbs., or about 30 inches heighth in the mercuriac glass. At a depth of 5,000 feet we have only a difference in vacuum of 5.3 inches. Thus, there can be little appreciable difference in the placing of a pump in the average mine shaft. —[EDITOR.]

A Valuable Innovation in Gauge Cocks

With the multiplicity of devices in the shape of gauge cocks upon the market, it would seem that there is small room for improvement in that line. However, we show herewith an illustration which demonstrates an innovation which will be gladly welcomed by all engineers.



No one knows better than the engineer the number of burns received in repairing leaky gauge cocks, besides which there is often the drip, drip of hot water leaving a yellow streak down the boiler front. With the Guethler Gauge Cock all this is said to be overcome, and in a manner so simple that anyone can repair it in five minutes without danger or inconvenience.

A study of the cut shows the lever pin (3) which sets in a slot (4). The lever (5) can then be raised and lowered at will without disturbing the parts. Now presume that we have a leak develop; all that is necessary for its remedy is simply raise the lever all the way back, slide it out of the slot (4), take it to a cool part of the room where the light is good and remove the seat (1). This seat is of soft metal and can be pushed out with a small nail inserted in the hole (7). A new set can then be slipped in and the cock hung in its place without having used a wrench or tool other than a small nail.

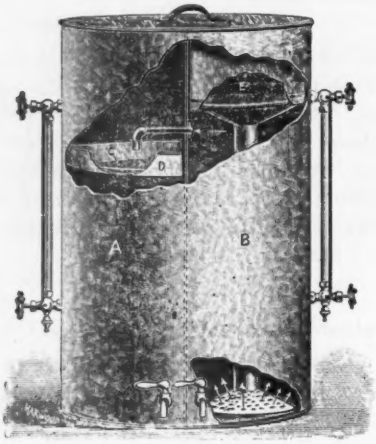
A strong feature of the device is that the raising of the seat from water (or steam) outlet (2) removes it from the direct line of blow, thus giving a straight way for the exhaust, eliminating danger of cutting the seat and permitting a better opportunity to observe the nature of what is blowing off—steam or waater.

The cock is patented by William Guethler, 3112 Arizona St., Philadelphia, Pa., who will be glad to mail illustrated circular or give ample demonstration of the value of the appliance to those interested.

The Sims Oil Filter

The "Sims Oil Filter" herein illustrated is winning its way among Steam Users, and is apparently popular with engineers because it is not difficult to clean. This is apparent from the description of its construction.

The Filter is made of heavy galvanized sheet iron, nicely painted with enamel paint, and is an ornament to any engine room. As will be seen by cut, the main tank is divided into two equal parts by a partition through the centre; the section



"A" contains the filtered oil, and has a capacity to hold a day's filtering; section "B" contains the water for filtering purposes, and as this may be within a trifle of the outlet, the column of water through which the oil ascends is more than twice as high as it would be if the filtered oil floated on the water; this secures more thorough washing of each drop of oil.

Its operation is as follows: the oil to be filtered is poured into tank "E", this tank has a perforated bottom, on which is a wool felt one quarter inch thick, the oil is filtered through this felt, decends the tube and passing through the holes in foot of tube, ascends through the water, passes through a pipe fastened to the partition, into a shallow pan, held on suitable legs, having a perforated bottom upon which is another wool felt, through which it is again filtered into section "A," where it is ready for use.

A coil is in section "B"—not shown in cut,—for the purpose of warming the water when necessary.

To clean the filter, run off the dirty water, remove tank "E", and pan "D" clean the pads by laying them on a board or dirty side downwards, then pour some kerosene oil through them and wash the impurity out; wipe the inside of section "B" and tank "E", fill filter with clean water, replace filtering pads, and it is again ready for business, without disturbing the filtered oil.

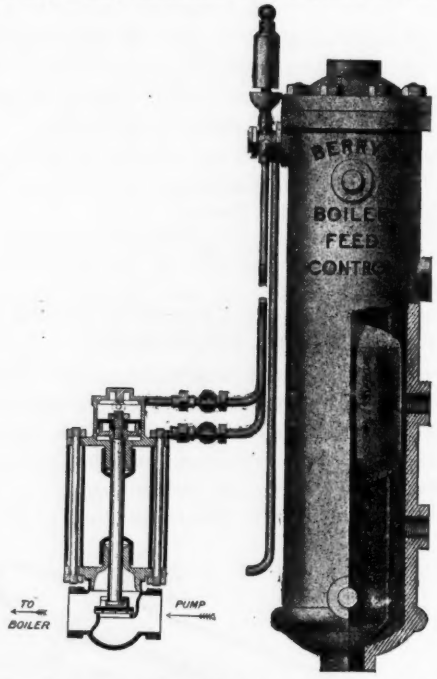
In the larger sizes an auxilliary tank is placed on the cover to receive the dirty oil, a fine sieve is let into the cover, the oil flows from a faucet through the sieve, into tank "E". In this case the cover does not have to be removed except for cleaning purposes.

These Oil Filters are made in sizes from three to one hundred gallons capacity, by THE SIMS CO., 162 E.21st St., Erie, Pa. They will doubtless be pleased to send their catalogue, prices and other imformation desired to any of our readers.

A Practical Feed Water Regulator

The value of automatic machinery has come to be generally recognized, operating with a precision and regularity which cannot be attained by hand operation.

Boiler owners seldom realize the enormous amount of energy stored in a boiler charged with the average steam pressure, unless they have seen the havoc from a boiler explosion. At the present time with the large factor of safety with which they are designed, and the careful yearly inspections most boilers are submitted to, it may safely be said that the predominating cause of explosions of this type now-a-days is low water. It is not to be understood by this that the water is always permitted to become so low as to allow burning the crown-sheets, such is not the case; but, the water is permitted such a varied range in the boiler,by letting it run pretty low then filling it to the limit of safety, that the material is subjected to the widest possible variations in expansion and contraction. This action going on from day to day finally terminates in a rupture of greater or less



degree; hence, the value of maintaining a fixed water line. The above is, of course, the principal reason for maintaining an even temperature, namely, the safety of life and property—but there are many features in the line of economy which prevail when a fixed water line is maintained. There is protection from priming, saving in fuel, etc.

As illustrating the fallibility of trusted, and to all appearances trust-worthy men, the recent case of a badly damaged boiler in Philadelphia, is remarkable. The watchman, of seven years experience, started the fire about three o'clock a. m., to have steam for an early start in the morning. He did not notice that the water was low for some time, and, when he did notice it, he opened the two blow-cocks, supposing that he was shutting them, and let all the water out of the boiler. Of course the boiler was badly damaged, but, being of a peculiarly safe construction, did not explode.

A few hundred dollars will repair the damage to the boiler; but, it is clear that with an ordinary boiler great damage might have been done to the building and a serious loss of life incurred.

There is a foolish prejudice against the use of automatic devices about a boiler, yet there is no part of a modern plant upon which more depends than upon the boilers; and it would seem that with the known fallibility of men as a factor of danger, every possible safe guard in the way of automatic devices would be used to assist the fireman in the discharge of his responsible duties.

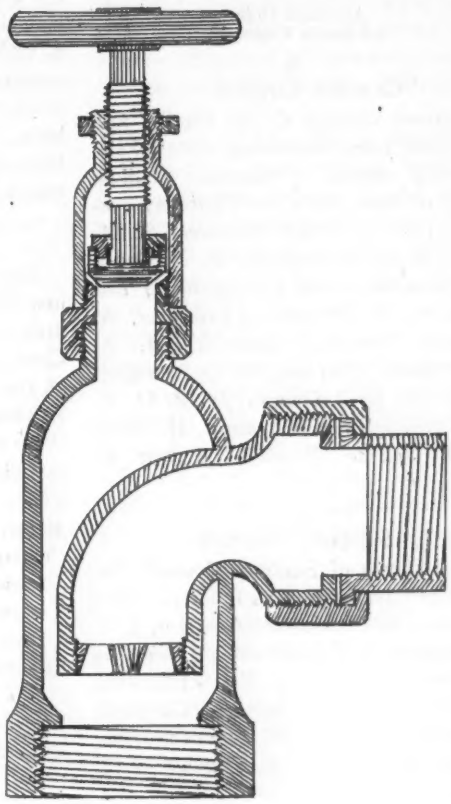
The accompanying illustration shows the Berry Feed water control system, manufactured by the Berry Engineering Company, Chester, Pa. This device is probably one of the most complete appliances for this purpose ever devised. The principle involved in its manufacture is the use of a float for the opening and closing of the valve mechanism. There are no diaphragms used in the machine the operation being altogether by steam admission and exhaust through direct passages. It also differs essentially from all others in that the whistle valve and wearing parts are easily removed for cleaning, or repairs, while the column is under pressure.

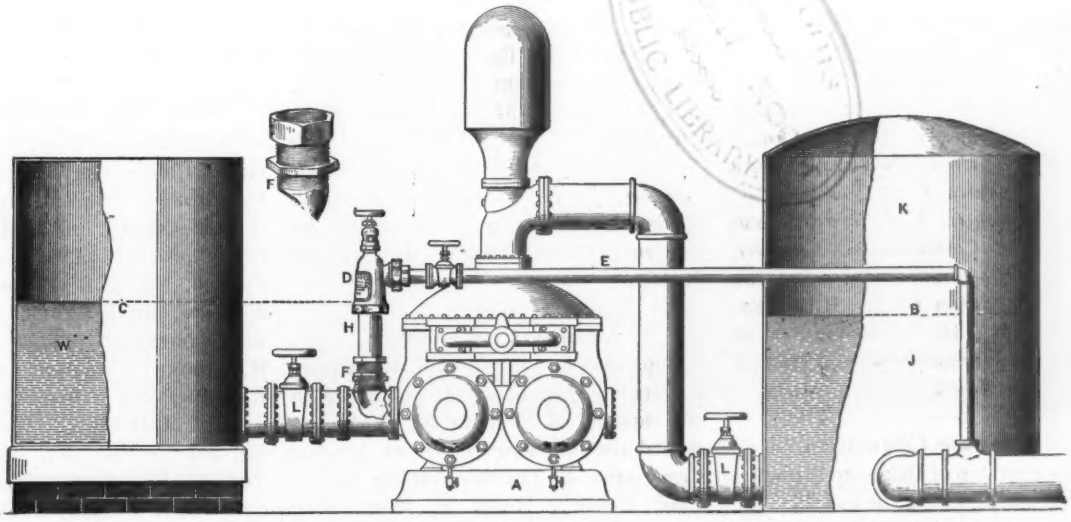
The Buffalo Air Injector for Hydraulic Elevator Service

Every engineer in charge of hydraulic elevators knows the importance of supplying air to the tanks in the proper quantities; therefore, the following description of an extremely simple and very effective device for supplying the necessary air will be of interest.

The Buffalo Air Injector is devised to readily supply air to the pump without requiring the water supply to be shut off from pump, unless the supply of water has a head of over 10 feet, then the supply should be partly shut off from the pump, as the air injector will not work successfully against a greater resistance of water.

This injector, which is manufactured by John G. Stamp, 202 Main Street, Buffalo, N. Y., is connected as shown in cut No. 1, which represents a portion of an elevator plant equipped with the Buffalo Air Injector and system of piping. A represents pump, B pressure tank, C open tank. Other letters represent different parts of any elevator plant, but D, E, F, and H represent injector and the system of piping. D is injector, E is pipe through which the injector is supplied with water under pressure from pressure tank. F is special fitting. Pipe E should be connected at the most silent part at the bottom of the pressure tank. It can be run to injector in the most convenient way to suit the plant, but not to disturb the location of injector. Pipe E is represented to be connected to the large pipe leading from pressure tank. H represent pipes leading from injector in which the mixed air and water takes its downward course to suction of pump. This pipe must not be changed in any way from condition shown on cuts.





Cut No. 2 represents Air Injector connected to suction pipe of pump; with special fitting screwed in shell of same

Cut No. 2 shows the sectional and exterior views of the injector and illustrates the method of operation conclusively.

Society News

American Order of Steam Engineers

Camden Council

Supreme Chaplin C. H. Pfeiffer and Past Chief Julius Abrahams, installed the following officers of Camden Council, No. 3, of New Jersey, on Thursday evening, July 3: *Chief Engineer*, S. M. Best; *Assistant Engineer*, H. B. Cordrey; *Recording and Corresponding Engineer*, C. H. Pfeiffer; *Treasurer*, A. Jordan; *Financial Engineer*, H. R. Taliaferro; *Chaplain*, W. C. Powell; *Sr. M. M.*, D. B. Owens; *Jr. M. M.*, C. H. Mathews; *Inside Sentinel*, H. Hewlings; *Outside Sentinel*, Joseph P. Whilley.

Sunbury Council

The officers of Sunbury Council, No. 19, Pennsylvania, are as follows: *Chief Engineer*, R. D. Mantz; *Assistant*, J. T. Heintselman; *Corresponding, Rocording and Financial Engineer*, Ed. Schreiber; *Treasurer*, Geo. W. Leister; *Chaplain*, Aaron Buck; *Sr. M. M.*, Edwin Snyder, *Jr. M. M.*, S. E. Lees; *Sentinel*, H. E. Culp.

Mr. Schreiber informs us that Sunbury Council is still doing nicely, and that though their opportunities are limited, their enthusiasm is boundless and they manage to have some interesting and enjoyable meetings.

Maryland Council, No. 1

The new officers of Maryland Council, No. 1, are as follows: *Chief Engineer*, L. Smithers; *First Assistant*, Frank Denton; *Treasurer*, Peter Hagan; *Financial Engineer*, J. C. W. Schrier; *Recording and Corresponding Engineer*, W. S. Smith, 533 Sharp St.; *Chaplain*, Geo. Disney; *Senior M. M.*, H. Dolen; *Junior M. M.*, H. Flaherty; *Inside Sentinel*, W. Johnson; *Outside Sentinel*, R. Burgman; *Trustee*, Jas. Gardner.

Delaware Council

The membership of Delaware Conncil is increasing steadily, and the meetings are very interesting. On July 8, Deputy Supreme Chief D. J. Stazton installed the following officers: *Chief Engineer*, Clark Franklin; *First Assistant Engineer*, John Roe; *Sr. M. M.*, John Schoford; *Jr. M. M.*, G. Hoffimer; *Inside Sentinel*, Chas. H. Davis; *Outside Sentinel*, Chas. Barker. The Delaware boys are talking of having adrawing for a gold watch for the benefit of the council, they are also looking forward to a visit from the Baltimore boys this summer. They want to see our big chief, Noah, and all the other Baltimore boys, but they have given notice that they will consider the party incomplete unless it includes McGee.

Pottstown Council

The officers of Pottstown Council were installed by Grand Chief Trout on Saturday evening, July 18. The Grand Chief was accompanied by about fifteen of the members of Progress Council of Reading, and the Pottstown boys showed them an enjoyable evening. The officers installed are as follows: *Chief Engineer*, Chas. Quinter; *First Assistant Engineer*, Walter Haley; *Recording and Corresponding Engineer*, H. L. Shirey; *Financial Engineer*, Harry Zollers; *Treasurer*, Jas. Warmkessel; *Chaplain*, Tobys Bieman; *Sr. M. M.*, Jacob Crater; *Jr. M. M.*, Geo. Hoffman; *Inside Sentinel*, Joseph Rhoads; *Outside Sentinel*, Clayton Fink; *Trustee*, Jacob Crates.

Energy Council

The officers of Energy Council, No. 2, Baltimore, are as follows: *Chief Engineer*, Thos. E. Eator; *Assistant*, J. W. Lutz; *Financial Engineer*, H. L. McGee; *Recording Engineer*, Jas. H. Stallings; *Corresponding Engineer*, T. O. Daneker, 834 East avenue; *Tresurer*, Chas. L. Schirmer; *Chaplain*, P. A. Kirkwood; *Sr. M. M.*, Fred May; *Jr. M. M.*, John L. Norton; *Inside Sentinel*, Alfred R. Sloman; *Outside Sentinel*, J. W. Sabines. The installation ceremonies were conducted by Supreme Chief Noah R. Bierson, on July 8.

Atlantic City Council

Supreme Chief Engineer N. R. Pierson, assisted by Jas. H. Stallings, acting in the capacity of Supreme Sir M. M., installed the following officers at Atlantic City Council on Tuesday evening, July 7: *Chief Engineer*, John A. Best; *First Assistant*, Wm. Gressman; *Recording Engineer*, W. S. Price; *Financial*, W. A. Hope; *Treasurer*, R. S. Petersen; *Sr. M. M.*, A. H. Francks; *Jr. M. M.*, W. W. Ferguson; *Inside Sentinel*, Jas. Heenan; *Outside*, Walter Ware; *Chaplain*, Warren Morris. After the installation ceremonies the members and guests proceeded to the Hotel Central, where one of Addor's famous suppers awaited them. The wants of the inner-man being supplied, the boys took in the sights on the boardwalk, including Ye Old Mill, the Laughing Gallery, and the Rudolph Grotto.

This was the first visit of Brothers Pierson and Stallings to Atlantic City, and the Supreme Chief was so well pleased that he did not return to Baltimore until the following Sunday. Bro. Stallings says its a great place.

Germantown Council

Chief Engineer, Geo. T. Lee; *First Assistant*, John Brayman; *Recording Engineer*, Jas. Rosboshil; *Financial*, Harry P. Fowden; *Corresponding*, Franklin MacIndoe; *Treasurer*, W. S. Wood; *Chaplain*, W. W. Leitch; *Sr. M. M.*, Edw. Reboul; *Jr. M. M.*, Wm. Kurtz; *Inside Sentinel*, John Atkinson; *Outside Sentinel*, Geo. C. Davis; *Trustees*, John Jamison, Wm. Topley and Wm. Doyle; *Delegates to Grand Council*, Leidy F. Souders, John P. Richerds.

Above are the names of the new officers of Germantown Council, No. 22, of Philadelphia. This council which was organized only a little more than a year ago, now has seventy-six members, and John Rickards says "it isnt half grown." Frank MacIndoe won the handsome gold badge offered by the Council to the brother bringing in the largest number of new members.

What Will They Do With It

On Monday evening, July 6th, Deputy Grand Chief John P. Rickards, assisted by Brother Frank Cannon, of Ppiladelphia Council, installed the following newly elected officers of Southwark Council, No. 4, of Philadelphia: *Chief Engineer*, Hugh Ryder; *Assistant*, Robert Cardwell; *Financial Engineer*, F. R. Moore; *Treasurer*, Wm. Schmall, *Recording and Corresponding Engineer*, J. C. McDowell; *Chaplain*, Chas. Meyers; *Sr. M. M.*, Geo. A. Banks; *Jr. M. M.*, Geo. Melchert; *Inside Sentinel*, B. F. Myrick; *Outside Sentinel*, Wm. Conner; *Trustee*, Wm. C. Simmons. The report of the auditing committee showed a cash balance of $4,000.00, on deposit, besides fifty shares of Building and Loan Association stock, What will they do with it?

Kensington Council

Chief Engineer, ED. C. RICKER; *First Assistant*, WM. DAVIS; *Sr. M. M.*, JAS. MCCARTNEY; *Inside Sentinel*, FRANK BUGGEY; *Outside Sentinel*, GOE. WHEATCROFT; *Corresponding Engineer*, ERNEST RITSERT; *Recording*, THOS. DONOVAN; *Financial*, HARRY MYERS; *Instructor*, CHAS. COOK. The foregoing are the officers of Kensington Council, No. 3, of Philadelphia, as elected for the ensueing term. Kensington is now in a more prosperous condition than ever before and are initating new members at nearly every meeting. The first Thursday evening of each month is still an open meeting to which all engineers, whether members of the order or not are invited.

Manayunk Council

Once every six months we hear from our friend John Clevenger, of the "State of Manayunk," then he sends us the names of the newly elected officers of Manayunk Council. If it was'nt for the elections we would probably never hear from John, so we are glad they have them. This time the successful ones are as follows: *Chief Engineer*, ANDREW ROBERTS SR.; *Assistant*, WALTER GUIE; *Recording and Corresponding Engineer*, JOHN CLEVENGER, 211 Lofty St., Manayunk, Phila.; *Financial*, GEO. CARPENTER; *Treasurer*, W. J. BEATTY; *Chaplain*, N. WARNER; *Sr. M. M.*, ELWOOD HEAPS; *Jr. M. M.*, D. DAVIS; *Sentinel*, J. PARKISON; *Trustee*, G. RICHARDSON.

Columbia Council

At their last meeting in June, the Columbia Council officers, at Columbia, Pa., were installed by Grand Recording Engineer A. Keppleman, assisted by Past Supreme Chief Williams. They are as follows: *Past Chief*, AMOS SIMMONS; *Chief Engineer*, JOHN MCLANE; *Assistant*, D. ECKMAN, *Corresponding Engineer*, W. J. COURTNEY, 804 Walnut St.; *Treasurer*, A. SIMMONS; *Sr. M. M.*, WM. RAUN; *Jr. M. M.*, HENRY MESSER; *Chaplain*, R. K. GROSH; *Inside Sentinel*, JOHN SCHLASSMAN; *Outside Sentinel*, CYRUS MOTHOIT; *Trustees*, JAS. DEVINE and ALBERT KIME.

On the same evening Columbia Council had as their guests, fifteen members of York Council who were wined, dined and handsomely entertained by the Columbia boys. The York boys drove to Columbia in a big buss, the distance is some twelve or fifteen miles.

Progress Council

At the regular meeting of Progress Council, No. 13, A. O. S. E., at Reading, Pa., Grand Chief Trout installed the following new officers: *Chief Engineer*, JOHN KELLENBERGER; *First Assistant*, FRED. M. KETNER; *Recording and Corresponding*, FRANK S. MILLER, No. 3, Franklin St., West Reading; *Financial Engineer*, GEO. F. MOYER; *Treasurer*, HENRY FRITZ; *Chaplain*, JACOB STONER; *Senior M. M.*, EDW. JONES; *Jr. M. M.*, JOHN F. SHADLE; *Inside Sentinel*, JNO. ZWEIZIG; *Outside Sentinel*, JOS. LIVINGHOUSE; *Trustee*, GEO. MILLER.

During the hot weather Progress Council will only meet every other week as follows: July 11, 25; Aug. 8, 22; and Sept. 5, after which they will again meet every Saturday.

Progress Council is progressing nicely; six new members were admitted during the past month, and the educational work has improved greatly.

Milwaukee Council

The new officers of Clifford P. Williams Council, of Milwaukee, Wis., are as follows: *Chief Engineer*, JOSEPH T. HARRIS; *First Assistant*, H. WILLIS; *Recording Engineer*, H. FOWLER; *Financial Engineer*, F. FROZEL; *Corresponding Engineer*, J. T. HARRIS, 1611 Clybourne St.; *Senior M. M.*, H. NOTHBOHM; *Junior M. M.*, F. HAYES; *Chaplain*, GEO. TOPPING; *Inside Sentinel*, A. WOTHBOHM; *Outside Sentinel*, M. OLSON; *Trustee for three years*, GEORGE TOPPING.

The officers were installed by Deputy Supreme Chief Engineer Harris, assisted by Past Chief Elmer Powers, acting as Senior Master Mechanic. After the installation ceremonies, there was a banquet at which some of the members displayed considerable ability as speakers, and some of these who didn't speak sang some good songs. Special mention should be made of the fact that the music was furnished by an orchestra composed exclusively of members, of the council and led by Brothers LeFrane and Hayes.

On Sunday, June the 21, the Council gave its third annual outing, which was a magnificient success. Early in the morning the members and their families embarked upon theer chartered suburban cars for Waukesha Beach, where a most delightful day was spent, the perty returning to the city at 7 p. m. The happy laughing party with their banners streaming and with a full brass band to furnish music, made a splendid showing as they passed through the city.

The day at Waukesha Beach was spent in games and outdoor sports for which a number of handsome prizes were given.

Philadelphia Council

Deputy Grand Chief Engineer John P. Rickards, assisted by First Assistant Grand Chief John J. Kelley, on Wednesday evening, July 1, installed the following officers of Philadelphia Council, No. 7: *Chief Engineer*, HARRY DUNN; *Assistant*, GODFREY KNOOS; *Recording and Corresponding Engineer*, W. S. WETZLER, 3707 Aspin St.; *Financial Engineer*, JOSEPH HIGH; *Treasurer*, WILLIAM J. ECCLES; *Senior Master Mechanic*, LOUIS HARTMAN; *Junior Master Mechanic*, SHEPPARD ADAMS; *Inside Sentinel*, H. EVERT; *Outside Sentinel*, JAMES MOSTOE; *Chaplain*, JAS. MOSTOE; *Trustees*, CHAS. V. GLENN and CLARENCE MUNCEY. Philadelphia Council now has over a hundred members.

Members of C. P. Williams Council and their families at Waukesha Beach

TRADE NOTES

The Kruger & Blind Co., 511 and 513 Master Street, Philadelphia, have recently enlarged their shops, and installed a number of new tools of the most modern type. which will enable them to do all kind of machine work, and make repairs to steam engines, pumps, etc., at the shortest possible notice. They have special boring bars for reboring engine cylinders in position, and valve ports of Corliss engines, portable milling machines for planing valve faces and special bar for boring taper crank pin holes.

The principal officers of this company have had a long experience in the engine repair business and are well known to many of our local readers. Mr. Kruger and Mr. Blind, were both with Wm. L. Simpson, formerly at 5th and Buttonwood streets for fourteen years—Mr. Kruger as draftsman and engineer and Mr. Blind as expert machinist.

The Thompson Damper Regulator, which represents several improvements in draft regulators, will be fully described and illustrated in the September number of The Practical Engineer

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A catalogue that gives several pages of information about the steam engine indicator and its use, together with a deal of instruction on the use of a planimeter, would naturally be appreciated by most engineers; that's why Jas. L. Robertson & Sons, 205 Fulton Street, New York, have recently been obliged to issue another edition of their catalogue. They will now send copies to any one interested, upon request.

The Cherry Chemical Company, 1215 Filbert Street, Philadelphia, Pa., manufacturers of the Red Seal Boiler Compound, make analyses of scale or water free of charge.

They invite all steam users to forward two ounces of scale, by mail, or one gallon of water, by express, prepaid. They will make an analysis, free of charge, and furnish an opinion of the grade of Compound they should use in order to remove the scale from their boilers without injury to the iron.

The care of belts situated in exposed places is always productive of hard work, because of the lack of resisting power which the average leather belt has in cases of unequal temperatures.

No one knows better than the engineer how quickly hot air or steam, dampness, or chemical gases, effects the quality of his belt. It will, therefore, interest the readers of the Practical Engineer to learn something about the new "Teon" belting now offered by D. P. Brown & Company, 262 and 264 North 4th Street, Philadelphia, Pa. It is a composite material, containing, along with the greatest possible breaking strain, steam, hot air, dampness and chemical resisting qualities not possible for leather belts to possess. A postal will secure one of their descriptive catalogues which contains much valuable data upon belts in general. Mention the Practical Engineer.

The blow-off valve is one of the greatest annoyances with which an engineer has to contend. The small particles of scale and sediment which are carried out with the water have been conducive to this condition, as they cut out the seat very quickly.

Even valves without seats, such as plug-cocks, cause equal trouble by becoming cut and scored in like manner.

In the Fober Blow-off valve will be noticed an innovation in this line which promises immunity from further trouble in cutting. The valve contains a very unique means of removing all sedimentary matter from the seat before the valves close. A more thorough description of this new valve may be obtained by addressing the Liberty Manufacturing Company, Pittsburg, Pa. When writing mention this paper.

It would hardly seem possible that any one would permit scale to accumulate in boiler tubes to the thickness of an inch, yet there are many instances where this much and sometimes more scale is found in boiler tubes. The cut shown

herewith was made from a photograph furnished us by the Lagonda Manufacturing Company, of Springfield, Ohio. It represents one of over 200 tubes in the boilers of a large street railway power-house in the south.

The engineers had no idea there was anything like this amout of scale. The water was very bad and having use for all the power the boiler would furnish, without any opportunity to shut down, the scale accumulated before they knew it. The Lagonda Company, who make a business of manufacturing tube cleaners, were then called in consultation and they inform us that they succeeded in cleaning the tubes. This company make several different types of cleaners and they also make a business of cleaning boilers by contract. They will be glad to correspond with any one interested. They publish an interesting catalogue which will be sent to our readers upon request.

When Corliss placed his governor and valve motion upon the market, he accomplished more real economy in the operation of steam engines than any other device ever adopted by the public up to the present time. It created a revolution in engineering circles second to none, despite the fact that it was necessary to expend two or three times the capital required to procure a good slide-valve engine.

However, if what is claimed for the Kuhlewind Momentum Governor is correct, we may realize a decided return to favor of the slide-valve type of engine.

The construction of this device is such that it will instantly give more steam when it is wanted, or cut off equally as quick when necessary, thus reducing the steam consumption to an exact minimum at all points of the load.

The advantages promised are so great that it will repay engineers to acquire a more intimate knowledge of it. When addressing an inquiry to the Kuhlewind Governor Company, 105 and 107 Pike Street, Pittsburg, Pa., for a very handsome catalogue containing full description of the appliance, which will be sent free to engineers, mention the Practical Engineer

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Mr. Geo. H. Gibson has resigned as manager of the advertising and publication department of the B. F. Sturtevant Company, of Boston, Mass., to accept an appointment with the International Steam Pump Company, having offices at 114–118 Liberty Street, New York City. Mr. Gibson was formerly connected with the Westinghouse Companies' Publishing Department, of Pittsburg, Pa., and was for two years a member of the editorial staff of the "Engineering News," of New York City.

Schade & Marshall, whose offices are in the Harrison Building, Philadelphia, have secured the agency for the full line of steam specialties manufactured by the Sims Co., of Erie, Pa. This line includes the Sims Feed Water Heater, Separators, Exhaust Heads, Oil Filters, Low Water Alarms, and numerous other specialties, nearly all of which posess some extremely novel and original features. An illustrated catalogue will be mailed upon request.

Engineers of wood-working establishments, lumber mills, etc., could often save themselves a lot of labor and save the firm a lot of money by having their boilers equipped to feed the fuel automatically. The cost of equipping most plants is trifling in comparison to the great saving in labor and wasted fuel. The Sterling Pipe and Blower Co., of Hartford, Conn., make a specialty of this class of work, and they will be pleased to submit plans and estimates and furnish full particulars to any one who is interested.

The Lee Projector M'fg. Co., formerly of Detroit, Mich., have removed to South Park, Port Huron, Mich., where they have a handsome large factory, 60′ x 150′, with a foundry attached which is 32′ x 60′, all of which is equipped with the latest modern tools. In addition to the well known Lee projector, this company also makes check valves, ejectors, cellar drainers, purgers attachments, water heaters, foot valves, etc. Write them for a catalogue if you are interested.

The Sims Co., of Erie, Pa., informs us that they have just received the third order for a 500 h. p. Sims Feed Water Heater from the Kirby Lumber Company. The Sims Company have arranged with H. E. Maxfield & Co., 136 Liberty Street, New York, to act as their representatives for New York and New England.

The Glacier Metal Co., of New York and London, has established a southern office at Richmond, Va.

Write to John M. Watts Sons, 123 So. Second Street, Philadelphia, for their catalogue of packings and engineers supplies. Mention this paper.

If you have any packing troubles send to D. P. Brown & Co., 264 North Fourth Street. Philadelphia, for a copy of their catalogue of packing. It shows some novel and interesting styles of rod packings and also illustrates the Lightning Packing Hooks, which are claimed to be the best tools made for removing old packing from the stuffing-box, etc.

High speed engines are superseding all other types in the operation of electrical generators up to the larger units. It thus becomes necessary for the average engineer to aquaint himself with those of the better type and he cannot do better than secure one of the handsome new catalogues of the Reeve's Engine Co., Trenton, N. J., a limited number of which will be sent to our readers free. The book contains a very elaborately illustrated description of the Reeves engine and also valuable information on the valve gear of this type of engine.

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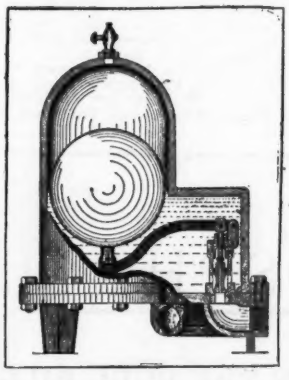

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These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

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An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

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DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Chief Engineer, L. Smithers. Corresponding Engineer, Wm. S. Smith, 533 Sharp St., Baltimore.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. O. Daneker, 834 East Ave.

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Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

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Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, in Templar Hall, 724 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

ROCKLAND.

Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Chief Engineer, Herbert W. Jones. Corresponding Engineer, James K. Sedgwick, Box 333, Rockland, Mass.

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Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at S. E. corner 2d and Arch Sts. Chief Engineer, S. M. Best. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

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Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, John A. Best. Corresponding Engineer, W. S. Price, Haddon Hall.

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Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Wm. F. Pond. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

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Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.

Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, George T. Lee. Corresponding Engineer, Frank MacIndoe, 3519 Ainsley St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Chief Engineer, Ed. C. Ricker. Corresponding Engineer, Ernest Ritsert, 2229 Frankford Ave., Philadelphia.

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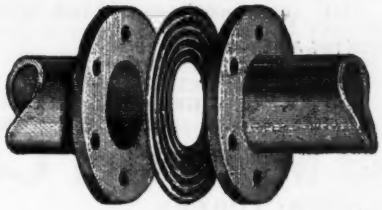

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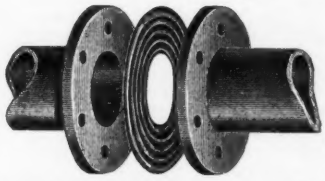

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Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, Andrew Roberts, Sr. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Thursday evening at Kensington Ave. and C St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Daniel Bunting. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

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Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, J. J. Stewart. Corresponding Engineer, Alex. Fraser, Carnegie, Pa.

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Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John evening at 639 Hamilton St. Chief Engineer, Henry C. Snyder. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Chas. Quinter. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, John Kellenberger. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, John McLane. Corresponding Engineer, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, R. D. Mantz. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

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Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

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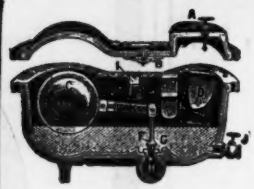

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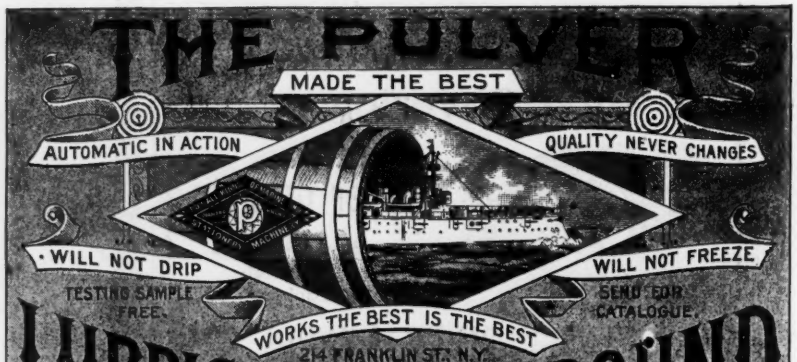

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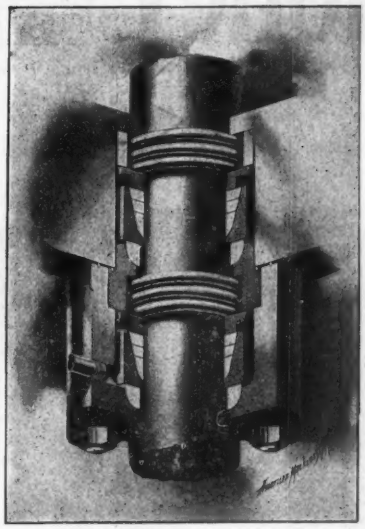

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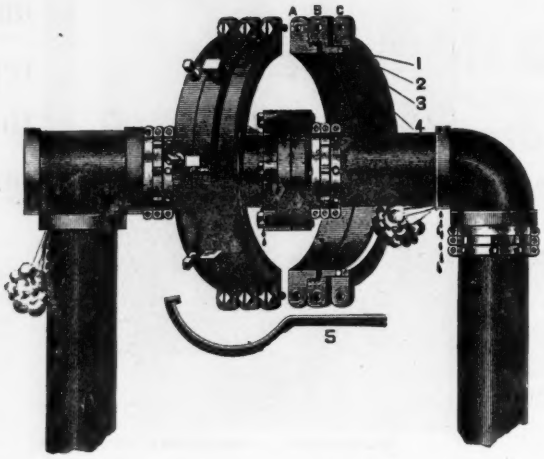

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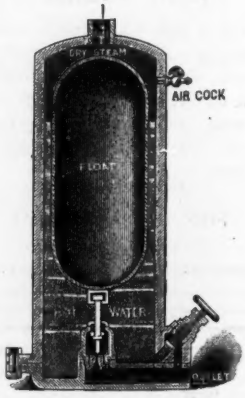

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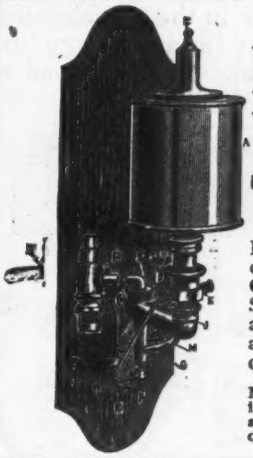

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GENTLEMEN:—Referring to your inquiry, we take pleasure in saying that we have had a Sims Oil Filter in use in our Ice Works for some months.

We had used three other filters prior to placing this one. We find that the "Sims" does better work than either of the others. The matter of cleaning is so small an affair that it is never neglected. The Filter has paid for itself many times since it has been in use.

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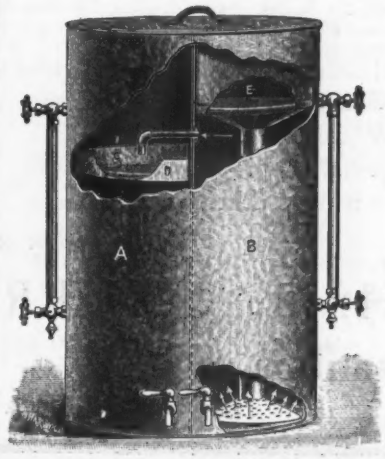
THE UNION ICE CO.



Write for Catalogue "E" and learn all about this Filter and the Steam Appliances we manufacture.

SIMS COMPANY, ERIE, PA.

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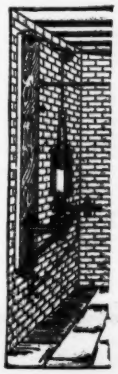

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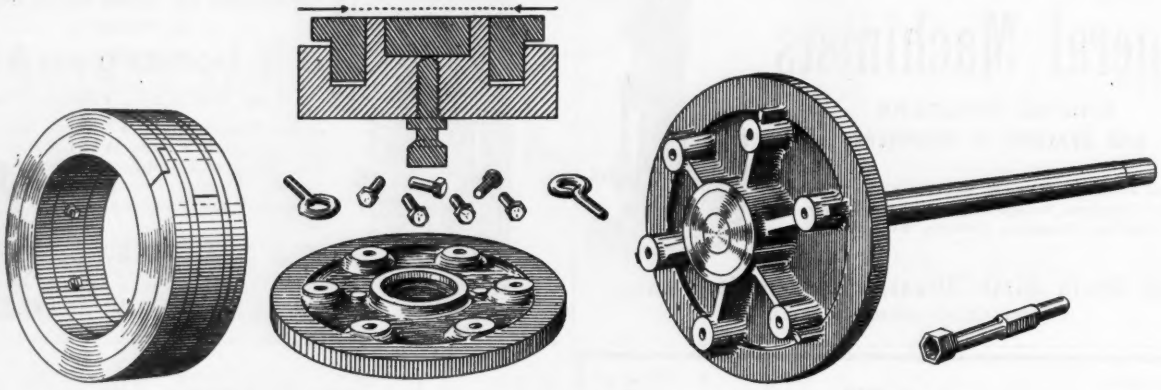
IMPROVED KELLAM DAMPER REGULATOR

ST. JOHN SELF-ADJUSTING
CYLINDER PACKING

It is false economy to put a good piston and packing into a cylinder that is out of round. If you put a good house on a poor foundation, both you and the house will be poor in a short time.

If the bore of the cylinder is not true, have it re-bored and put in our adjustable piston and St. John Self-Adjusting Cylinder Packing, and we will guarantee a perfectly steam tight cylinder.

A very slight leak in the cylinder of an engine making sixty revolutions a minute, running nine hours a day, means a large loss of coal every week, and this means money, as it takes the coal to make the steam, and money to pay for the coal.



The St. John Piston and Packing have stood the test of over fourteen years in actual use, and the practical use of it and the satisfactory results obtained, are the best proofs of its efficiency.

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The St. John Rings are not new to me. I have had them in the Tug Roman about 13 years; they have never leaked in all that time, and the cylinder is as perfect to-day, inside, as the day it was built. We find it takes from 5 to 7 pounds less steam to turn the engine with "St. John Rings" than with those of the old style.

From Carbon Iron and Steel Co., Parryville, Pa.

Since putting your St. John Packing on our engine, we are getting better results from her, and are using 25 per cent. less boiler capacity to do the work.

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First-class engineers want first-class work, as they know this is the only kind of work that pays around an engine, and they also know this is the kind of work turned out by H. B. U. &. Co.

Our specialty is repairs to engines. When you have work of this kind done, have it done right; it pays in the end.

We don't do or recommend cheap work

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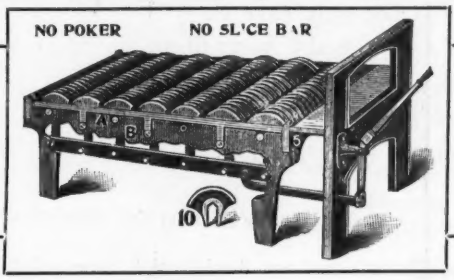

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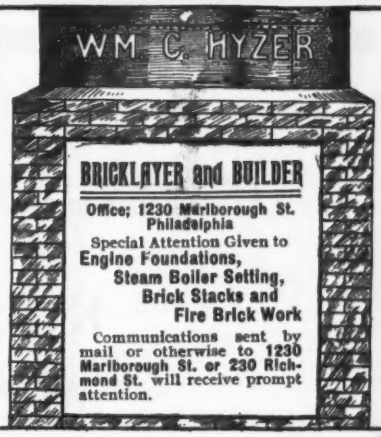
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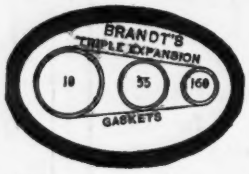

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not only save their cost in coal in six months, but make your plant do more work and more regular work.

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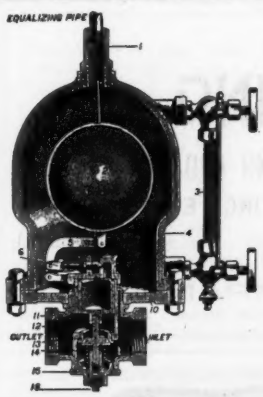

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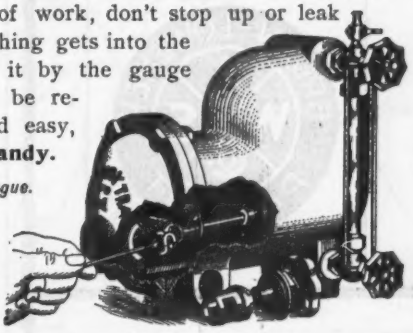

THE Handy Trap,
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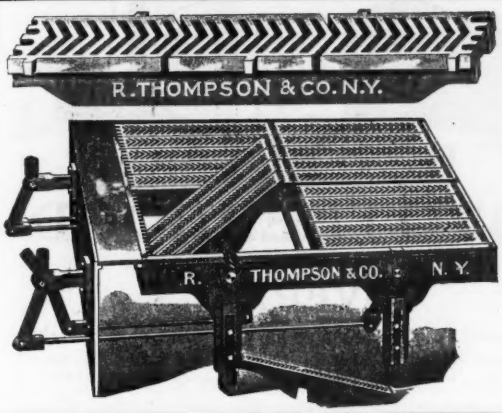

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Cleans the tubes without admitting steam into them. The soot goes up the chimney.

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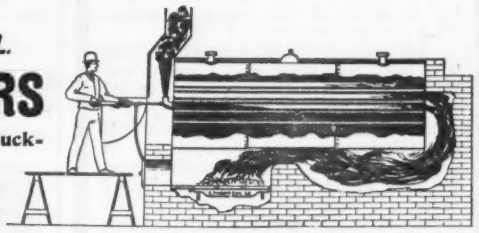

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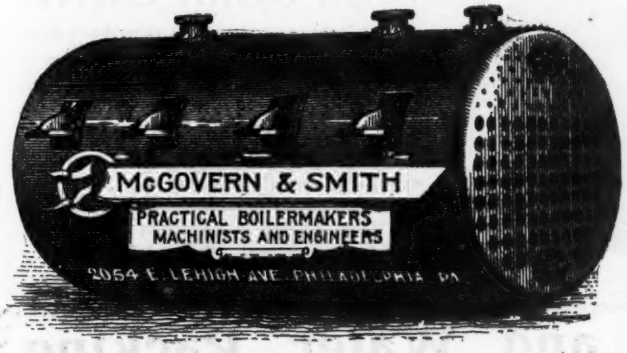

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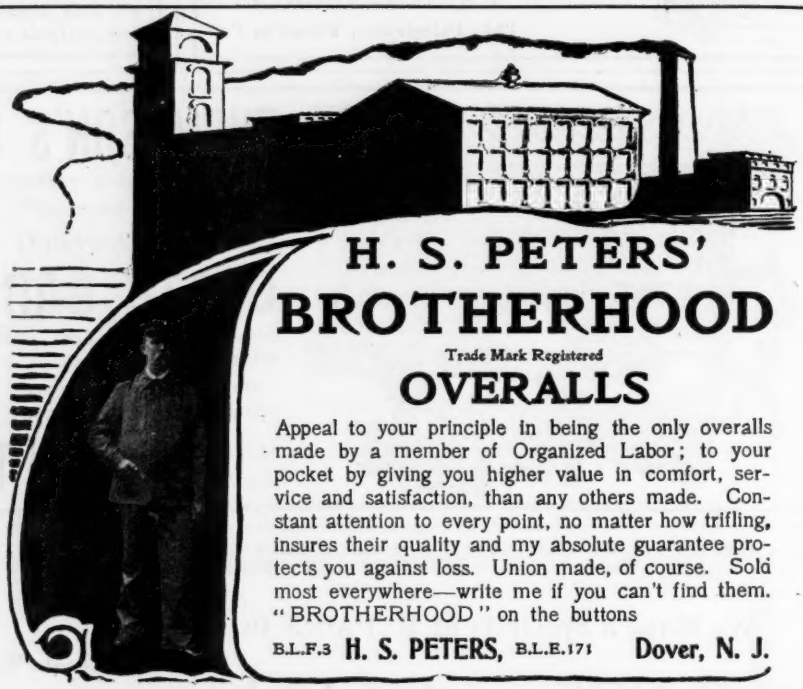

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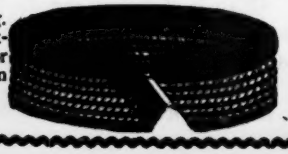

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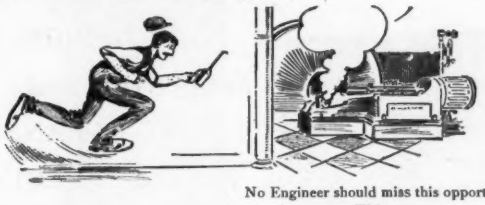

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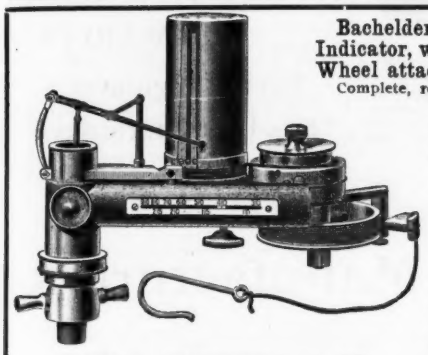

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Complete, ready for any pressure or stroke.

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Reads both Area and M. E. P. No chance for error.

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REGRINDING
REVERSIBLE
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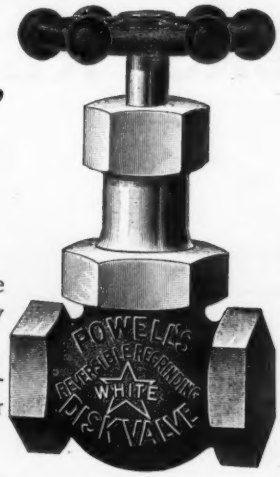

have a longer life and are easier to repair than any valve made.

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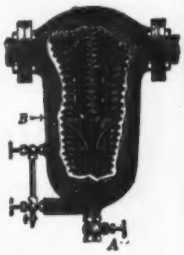

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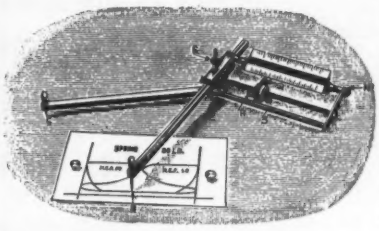

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SOOT EJECTOR
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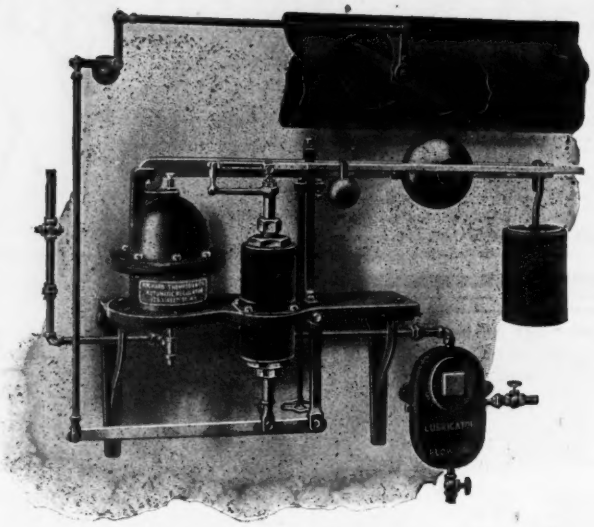

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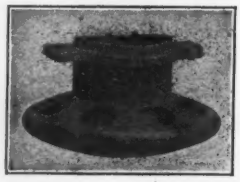

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Thirty days' trial without expense to you is my guarantee.

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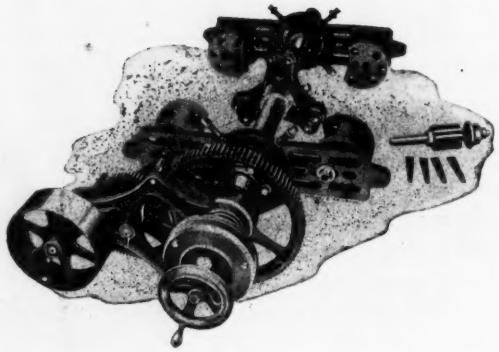

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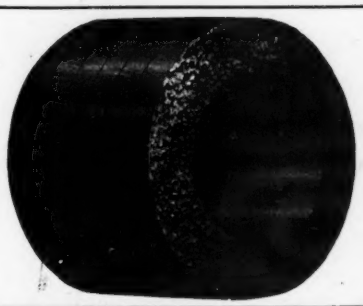

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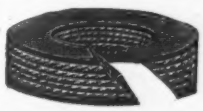

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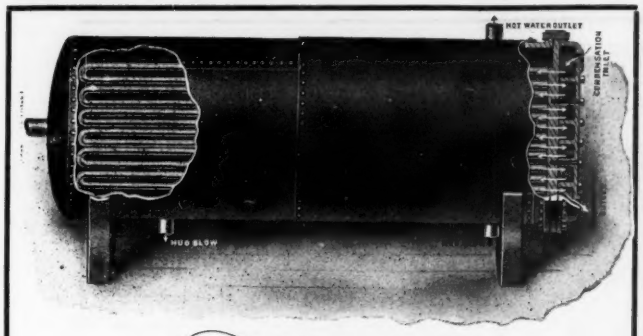

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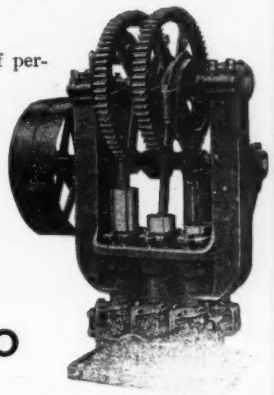

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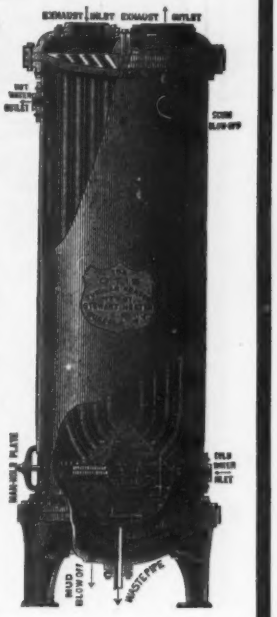

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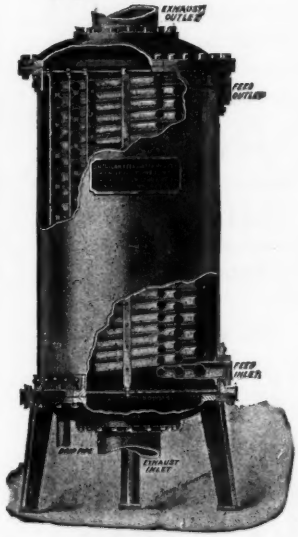

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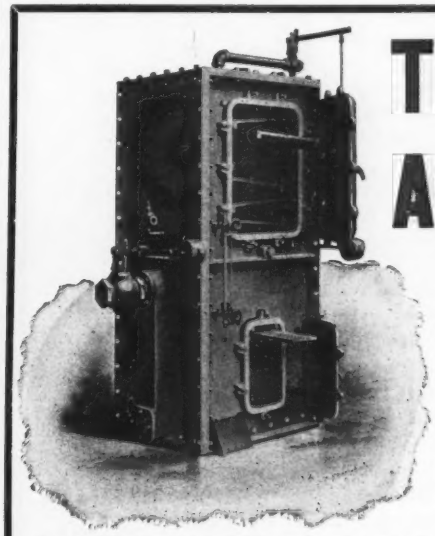

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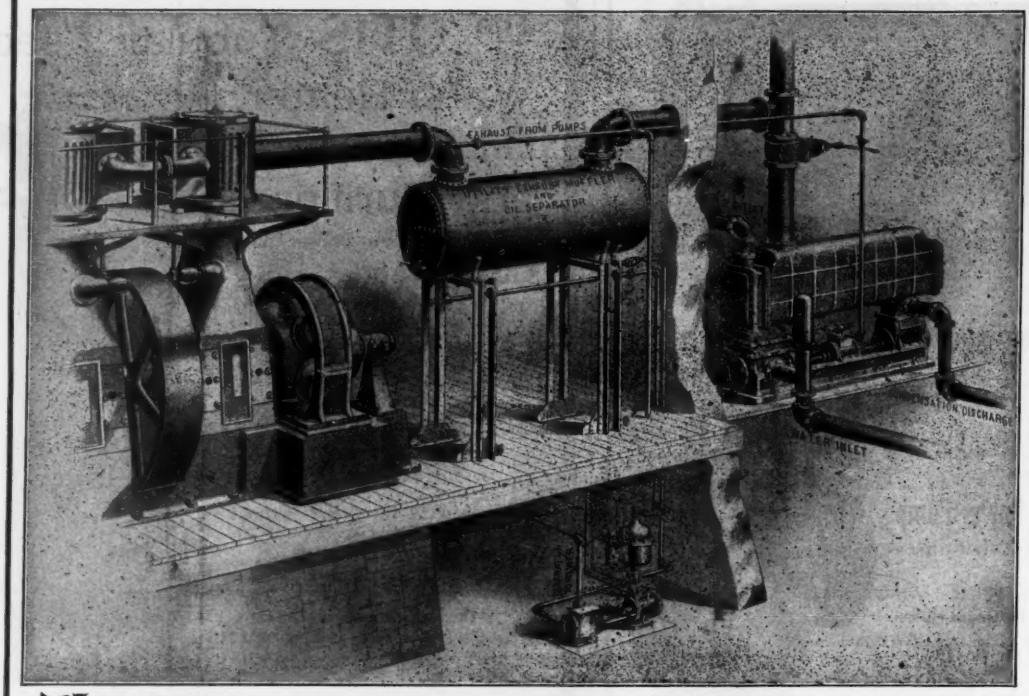

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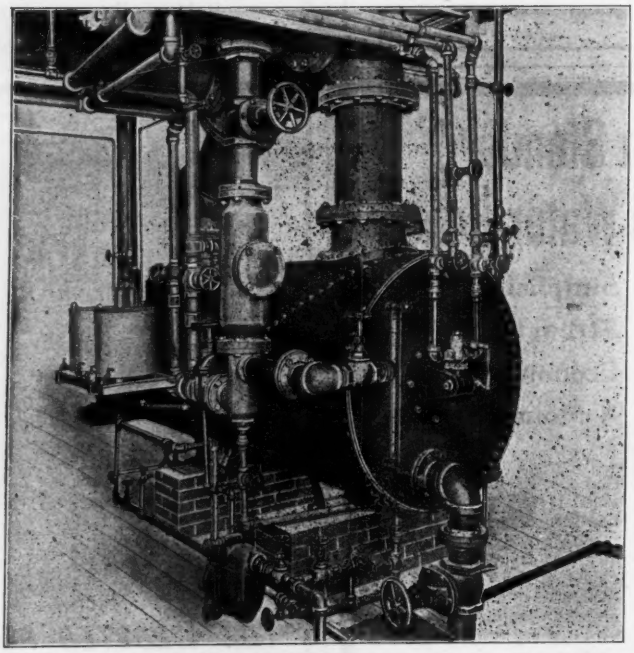

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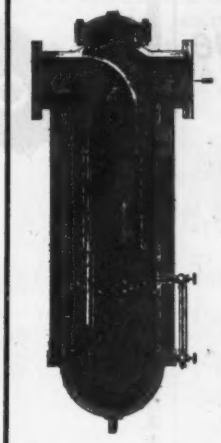

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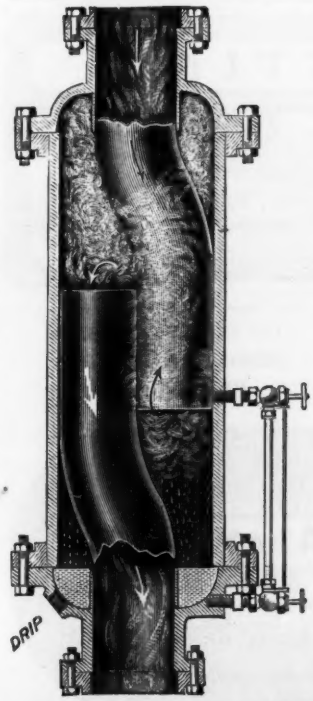

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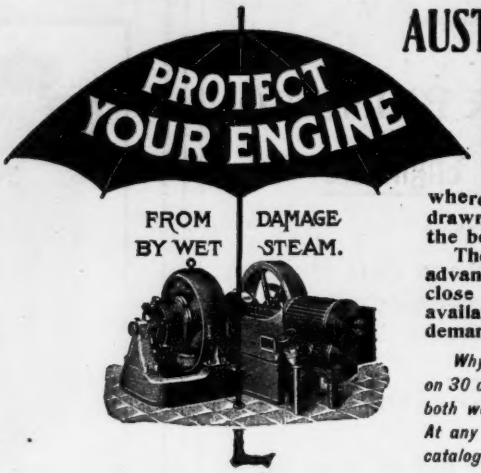

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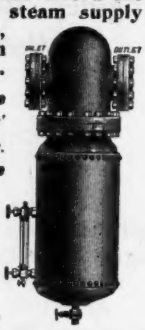

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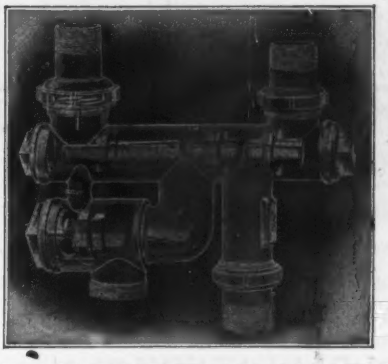

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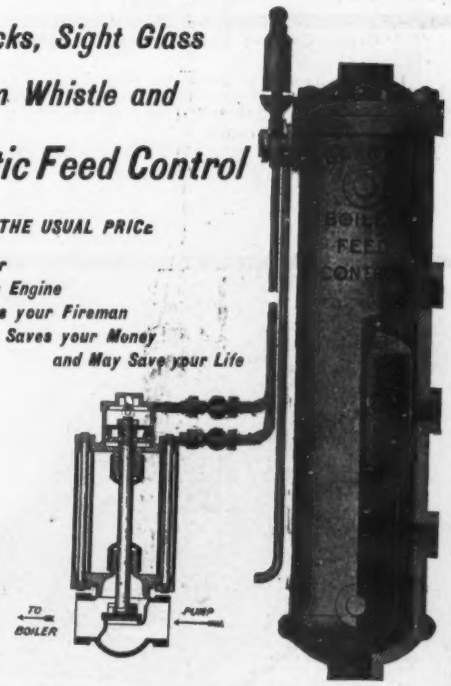

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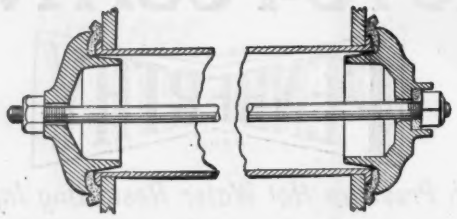

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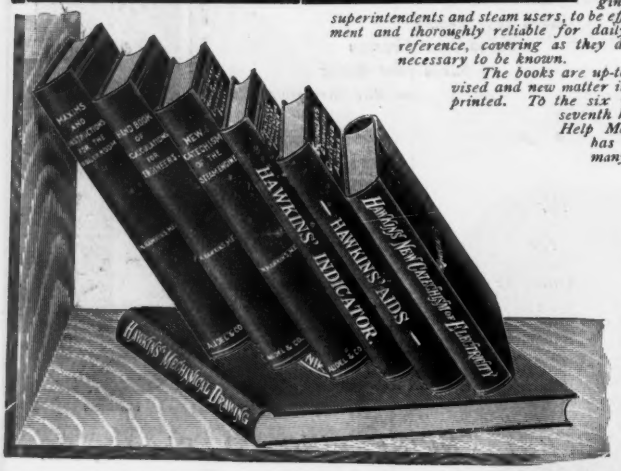

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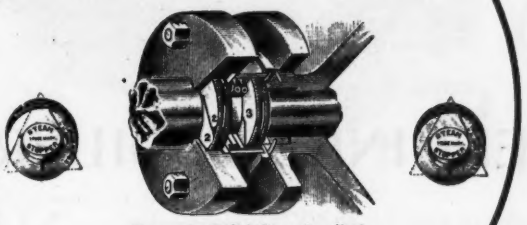

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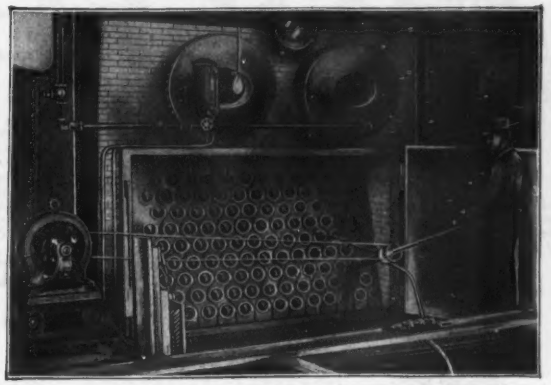

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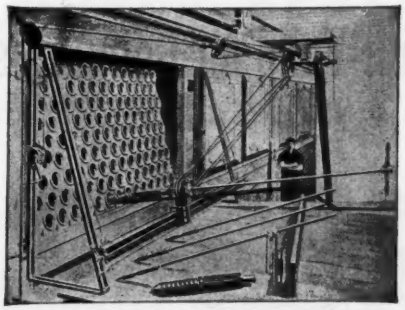

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Are the oldest and most efficient Boiler Tube Cleaners on the market. They take out all the scale.

The Gem Flue Scraper

does the same for Smoke Flue B cile

We also make **Gem Oilers,** Patent or Plain, **Torches and Heavy Brazed Steel Oilers, Flexible Shafting.**

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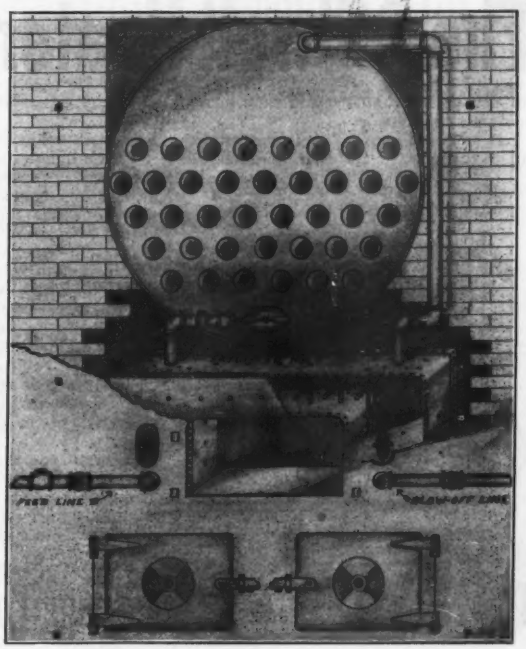

Saves the need of renewing brick arch; lasts as long as the boiler; increases capacity; does the work of a feed-water heater, and saves its cost in coal in a few weeks. You can't afford to be without it.

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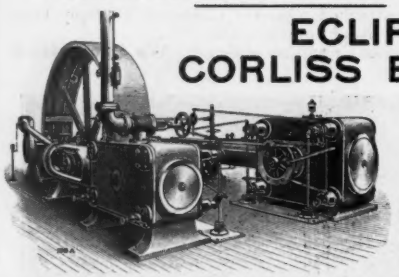

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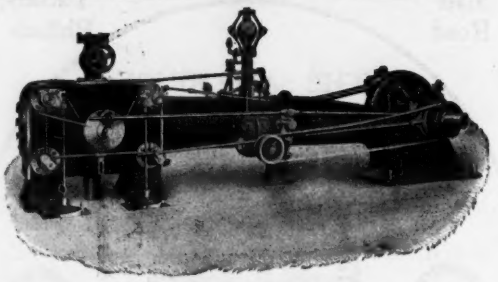

ENGINES AND BOILERS

PITTSBURG, PA., June 30, 1903.

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DEAR SIRS:—As for the Atlas Engine I can praise it the very best. For four years I have had charge at Mohn Bros. Laundry, in all that time we had no trouble whatever. I can recommend it very highly. Yours trely.

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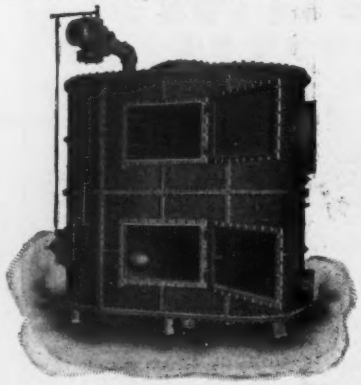
will use your exhaust steam and furnish pure hot water for your steam boilers.

It will heat your water as hot as the exhaust can make it, and do this always, and there will be no deterioration in heating efficiency because of age or because some one has forgotten to clean it.



It will give all the purification obtainable with exhaust steam, saving the exhaust in doing the heating, saving the returns and live steam drips and giving purification in other ways.

There are other advantages derived from the use of this Heater, fully explained in our catalog.

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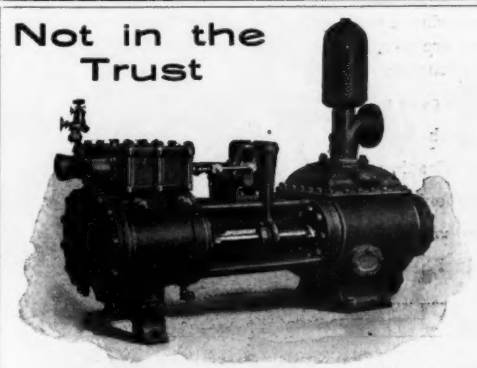

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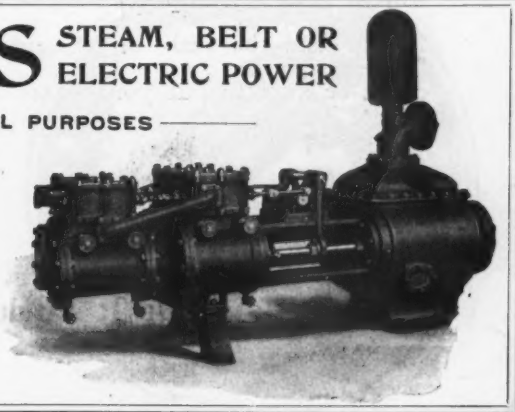

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Remedies to Suit Every Case

We have no fixed boiler compound. We analyze the scale from your boiler and thus find out just what the particular water you use requires to make it suitable for use in a boiler. With this information in our hands, we make a special compound which will keep your boiler free from scale. This will decrease the cost of fuel and increase the efficiency of your boiler.

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Fill out the coupon, giving data requested thereon, and send us a sample of the scale from your boiler whether you intend purchasing or not. If you send the scale under separate cover be sure to put your name and address upon it.

Don't Delay—Do It To-day

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Gentlemen:—I am sending you a sample of scale from our boiler. In accordance with your offer in the June PRACTICAL ENGINEER you are to analyze it, and send me certificate of analysis free of charge.

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Frequency of opening the blow-off during working hours.....
River or other source of water supply.....
Boilers are used about..... hours out of the 24.
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RAIN OR SNOW, FROST, THAW OR DRAUGHT DO NOT AFFECT IT

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The Teon Belt is the only belt of its kind; its basis is a specially woven fabric, the best and strongest procurable, made up without joint or seam, and cemented together under **enormous pressure.** To add to the great strength of its material, it is **metal sewed** and extra stitched—example: six ply Teon has a tensile strength of **one ton per inch of width.** The cement, a secret preparation, is the prime factor in enabling it to withstand the conditions which destroy leather, rubber, duck or other material. No ingredient used is influenced by any heat under **230° Fahrenheit;** the belt will therefore run perfectly in that temperature. **Teon will not stretch,** every belt having been passed through the most powerful stretching machinery in the world. It has a fine driving surface which renders **slip rare** and easily remedied. Scientific tests have shown its ability to withstand steam, water, acid, ammonia, caustic soda, lime and other chemicals. These tests, with the names of the persons who made them, and testimonials from some of the largest firms will be cheerfully furnished, with samples, prices, and complete information. **All belts are sold with a guarantee that the claims above are correct or money refunded.**

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OIL PROOF RING PACKING WITH IMPORTED COMPOUND CUSHION AND SPECIAL METALLIC PROTECTION

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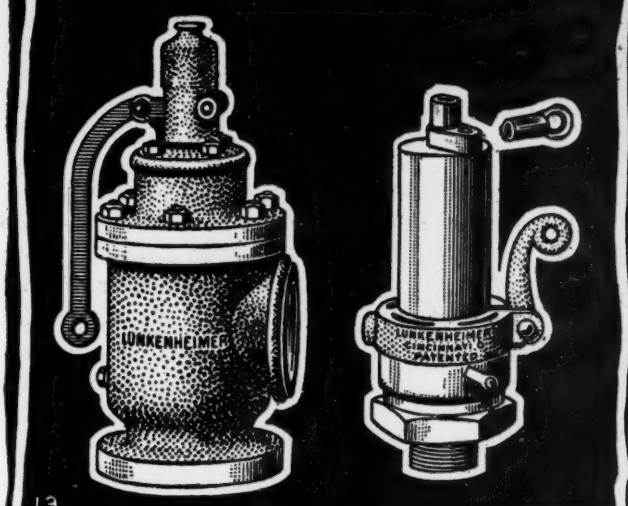
THE LUNKENHEIMER POP SAFETY VALVES

for STATIONARY, PORTABLE & MARINE STEAM BOILERS



Are made of the best materials, provided with large springs, have full relieving capacity and always prompt and reliable in operation. In brass top or angle outlet, ⅜ inch to 3 inches; in iron, brass mounted, screw or flange ends, 2 inches to 6 inches. Also furnished with nickel seats, if desired. All valves rigidly tested and inspected and warranted to satisfy. Specify *Lunkenheimer* make and order from your dealer.

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Use Jenkins '96 Sheet Packing on the worst joint you have, and if it is not what we claim we will refund the money.

JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.

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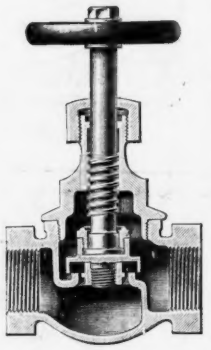

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Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, Lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water.**

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For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement.

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